APR 10 1923

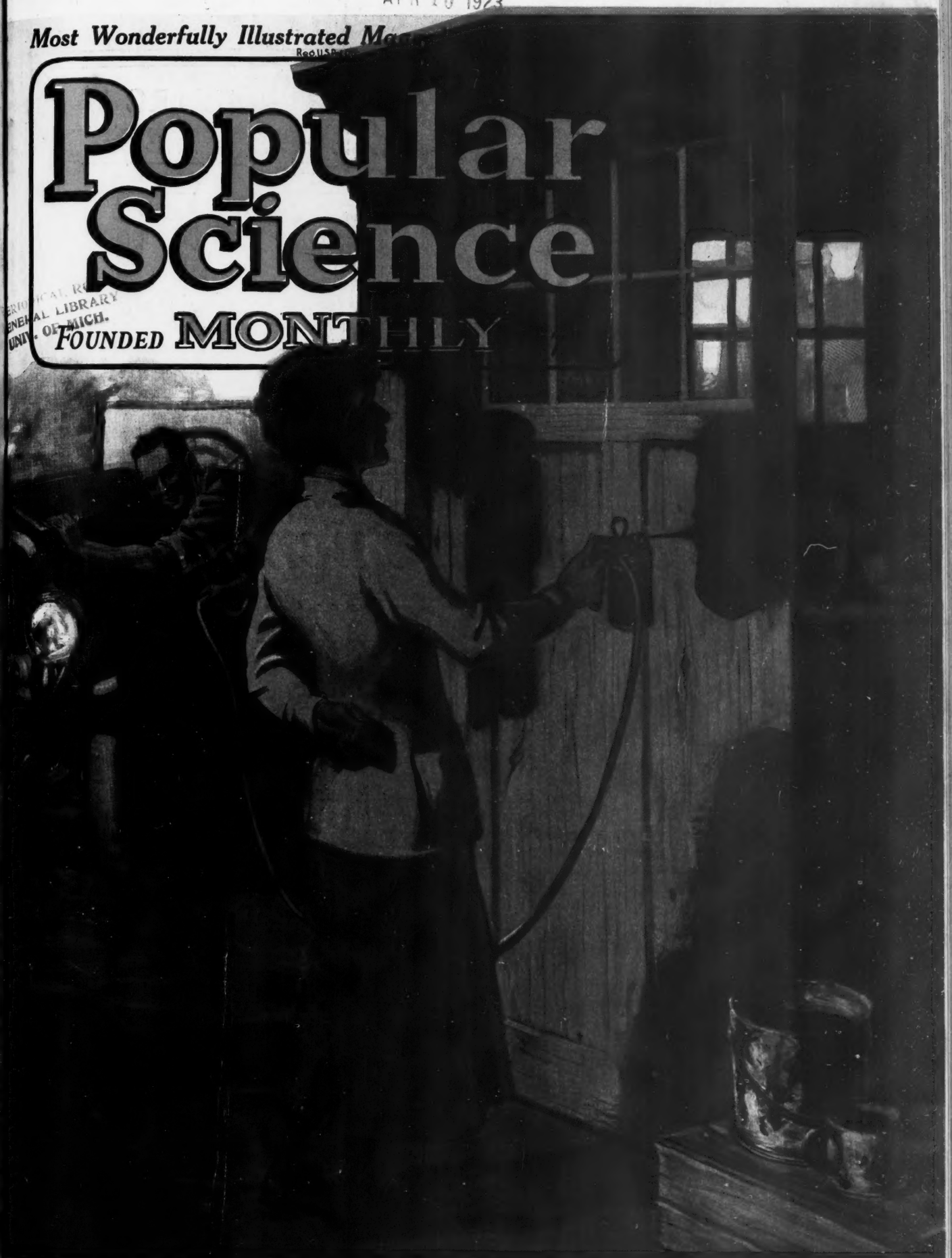
Most Wonderfully Illustrated Ma

Reg. U.S. Pat. Off.

Popular Science

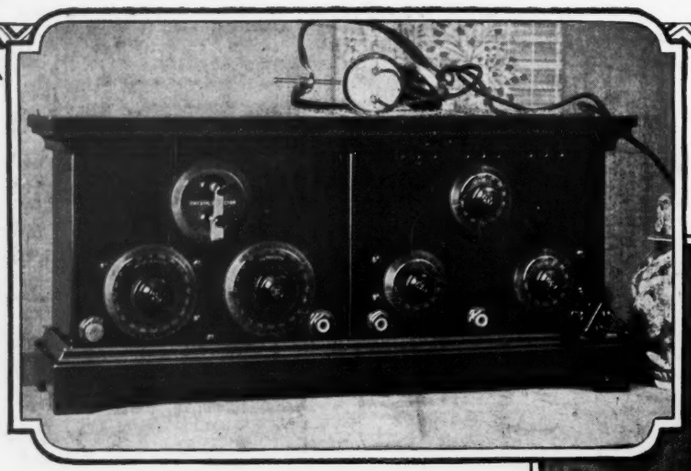
PERIODICAL RO
GENERAL LIBRARY
UNIV. OF MICH.

FOUNDED MONTHLY



MAY Tire Pump Operates Ingenious Paint Sprayer—Page 79 25 CENTS

Will Rogers Tells Why We Laugh

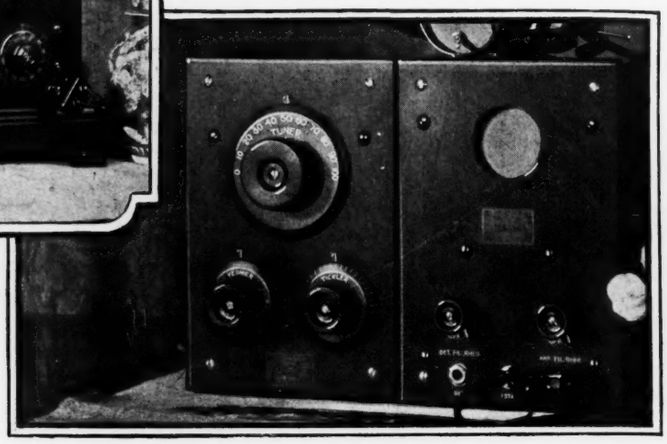


Radiola V

Radiola V is built for a life time—solidly—ruggedly. In principle and performance, it is the same as Radiola RC—detector with two stages of audio amplification. With the same long distance reach. And the same keen sensitiveness. A pleasing and unobtrusive piece of furniture in its neatly finished metal casing. Dependable always—and simple enough for anyone to operate.

Radiola RC

Radiola RC is one of the nation's most popular long distance receivers. Compact—efficient—with a sensitive detector, and two stages of amplification, for louder, clearer reception of distance. Finely made—and attractively finished—of solid mahogany.



A New Improvement Lowers the Cost!

Dry Cells Replace Storage Batteries

A new vacuum tube has made it possible. Radiola V and Radiola RC have been topping them all in popularity for dependability and long range—receiving over thrilling distances—up to 1,500 miles and more. Now both are converted to dry battery operation. This means greatly lowered cost—does away with bulky storage batteries—gives the far-away farmer the same good service it gives the city man.

No more need for expensive storage battery and charger. A big saving! And a saving made greater by the new offer—a combination offer of receiver and accessories—complete at a price remarkably low.

"There's a **Radiola** *for every purse"*

at the nearest Radio or Electrical Store

This symbol of quality is your protection

Radiola V *or* Radiola RC Complete $142.50

The New Way: Complete for dry battery operation, including three WD-12 Radiotron vacuum tubes; head telephones; "A" battery consisting of three dry cells; "B" battery consisting of three 22½ volt units. $142.50.

The Old Way: The price of Radiola V or Radiola RC when equipped for storage battery operation, formerly came to $207.50.

Send for this Free Booklet

If you can't have a $350 Radiola—want something bigger than a $25 Radiola—write for the booklet. Plenty of in-between sets. The booklet tells all about 'em.

Radiola

REG. U.S. PAT. OFF.

Radio Corporation of America

Sales Department
233 Broadway
New York

District Sales Offices
10 So. LaSalle Street
Chicago, Illinois

433 California Street
San Francisco, California

RADIO CORPORATION OF AMERICA
Dept. 2 P. Sc., 233 Broadway, New York
Please send me your free Radio Booklet.

Name

Street Address

City R. F. D.

State

THEY SAY—Comments of the Month by Men of the Hour in Science

DR. PERCY STICKNEY GRANT

Rector of the Church of the Ascension, New York City, who boldly has faced the issue of harmonizing the church with modern science:

"I WOULD much rather be the bright son of a peasant than the degenerate son of a duke, and I would much rather be on the upgrade from an ape than on the downgrade from Adam. And it makes a great deal of difference to our religion which ideas we have; whether we think we are all laboring for higher and higher human evolution, or whether we are rolling in the dust and complaining of that story of Adam and the apple and poor Eve.

© Keystone

Dr. Percy Stickney Grant

"We at least have the right to disencumber our minds from these ancient theories of creation and thought of God and these myths as to how man came into the world and where his troubles came from. It goes without saying that we have got to disencumber our minds of a great deal of the material that lies at the basis of ordinary theology today.

"What we want to do is to make the foundations of religion firmer and put those foundations right where the young people understand and see them—on science."

EDWARD B. CRAFT

Chief Engineer, Western Electric Company, speaking at a recent meeting in which two large audiences, separated by nearly 1000 miles, listened to the same addresses by radio:

"THE loudspeaking telephone system will tend to reestablish oratory by making it possible for the nation's leaders to sway great audiences."

DR. HUDSON MAXIM

Scientist and inventor, speaking before the National Cotton Conference for Boll Weevil Control:

"IT MIGHT be worth while to try the use of a lure made from the female moth of the boll weevil as a bait for catching males or in leading them to sip poison. Smell is the guiding sense of insects in the discovery of their mates.

"Experiments with flies, moths, and other insects show they are provided with very highly developed olfactory organs, which give them a keenness of scent that would shame a hound. They appear to have a sort of radio sense.

"It was demonstrated by experiment with silkworm moths that the male moth can smell the female at a distance of two miles.

"The boll weevil lure might be made with the use of a preparation made from the entire insect or some sort of fluid extract. It might be possible to discover some solvent that would dissolve only the aroma secretions of the female moths."

BENEDICT CROWELL

Former Assistant Secretary of War, and now one of the directors of a proposed dirigible air service between New York and Chicago:

"IF THE Germans had helium, the story of the Zeppelin in the war would have been different.

"Helium is contained in certain natural gases, especially in Texas, and we have spent large sums in developing processes for its separation. Progress has been made, and today we are able to produce helium in considerable quantity.

"We expect great improvement due to recent certain inventions. We have, therefore, continued our interest in dirigible airships for commercial use."

THOMAS A. EDISON

"A GREAT field for invention is the heavier than air machine that goes straight up. James Gordon Bennett once gave me $1000 to experiment. I made a machine that weighed only 80 pounds, but it did not do the trick. I scorched my hands and burned most of the hair off my head trying to perfect it, but I didn't. There is a great field for the helicopter."

DR. CHARLES P. STEINMETZ

Chief consulting engineer of the General Electric Company:

"THE biological engineer may enable the world to support many times its present population by producing energy crops and by feeding the human race on proteins produced by microorganisms.

Dr. C. P. Steinmetz

"What an advantage we should have by developing or creating new species of microorganisms that reproduce at an economically rapid rate! We have done much in producing new plants, but each generation takes about a year; but in microorganisms we may have a generation a day or several generations.

"In our time we have seen the sugar beet doubled in size and sugar content by the application of scientific methods. Working in the same line with other plants, probably fast growing grasses, why would it not be possible to breed a type of vegetation that might be called an energy crop, fixing solar energy on a large scale?

"Within a century or two, or even a shorter time, we could supply the world with food, not through cultivation of new areas for the growing of wheat, but by producing it through microorganisms without depending upon sunlight."

LEE DE FOREST

Noted radio pioneer and inventor.

"UNDOUBTEDLY, the fields where a poor boy starting out by himself can carry on inventive research unassisted by well-equipped laboratories of large corporations, are extremely limited.

"In this respect radio offers exceptional advantages. Research work in many of the departments of the radio field requires comparatively small and inexpensive laboratory equipment. I would mention particularly the problem of static elimination on which so many radio experts have labored more or less unsuccessfully for the past 20 years.

© Keystone

Lee De Forest

"*A simple and reliable calling device for radio receivers that can be manufactured and installed at low cost, offers another attractive problem.*"

PROFESSOR WILLIAM STARR MYERS

Department of History and Politics, Princeton University:

"OF 105,000,000 persons in the United States, statistics show that 45,000,000 are subnormal and never would have even the mentality of a child of 13; 15,000,000 are feeble minded and their brain power forever would be that of a child of eight. Of the remaining 45,000,000, at least 25,000,000 are classed as mediocre; 5,000,000 are rated as Class A in mentality, and 15,000,000 as Class B.

"Class A and Class B do the work of the citizenship of the country."

PROFESSOR FREDERICK J. ROGERS

Of the Physics Department, Leland Stanford, Jr., University, whose body accidentally came in contact with a 3000-volt electric current—a voltage usually used for electrocution:

"ELECTROCUTION is an entirely painless method of inflicting death. It knocked me cold. I never had a pain or a pang—in fact, never knew what happened to me until I was revived 15 minutes later.

"I can't describe how it seems to be dead, for I have no recollections of any sensations until I was revived.

"Death in electrocution is usually caused by stoppage of the heart. Sometimes stoppage of respiration causes asphyxiation."

"The wise man, said Confucius, does not esteem a person more highly because of what he says. –"
The wise radioist is not misled by extravagant claims, he knows that only a
Grebe Receiver
can come up to his expectations.
Doctor Mu.
Musings of Doctor Mu.
GREBE RADIO
A. H. GREBE & CO., Inc.
Richmond Hill, N. Y.
Western Branch
451 East 3rd Street, Los Angeles, Cal.
Write for "Musings of Dr. Mu."
Licensed under Armstrong U. S. Pat. No. 1113149

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
MAY, 1923

Is Rainmaking Riddle Solved?

Amazing Success of Fog-Blasting Airplanes Brings New Attempt to Produce Heavy Rainfall by Spraying Storm Clouds with Electrically Charged Sand

By Manus McFadden

OF ALL the marvelous achievements of modern science there is none that offers more dramatic possibilities than the recent amazing demonstration of two scientists who claim to be able to make, at will, rain, by precipitating clouds, or sunshine, by dispelling fogs.

Dr. Wilder D. Bancroft, professor of physical chemistry at Cornell University, and L. Francis Warren have actually succeeded in annihilating clouds and precipitating snow by spraying them with electrically charged sand at McCook Field in Dayton, Ohio. Their efforts, unlike those of other experimenters, have been based on chemistry rather than meteorology.

What It May Mean

Think of it!

Rain when you want it. Sunshine when you want it. Los Angeles weather in Pittsburgh and April showers for the arid deserts of the West. Man in control of the heavens—to turn them on or shut them off as he wishes.

It seems incredible. But if experiments so far successfully carried out fulfil their promise, it will be a scientific reality of tomorrow. Its application to everyday life is now considered by eminent meteorologists only a matter of time.

Farmers who have prayed for rain as they watched moisture in the form of clouds ironically pass over their heads; ship owners who have been worried and harassed by fogs; dwellers in the arid desert and those living in misty lowlands; residents of smoke-shrouded cities in the denser centers of population; in fact, persons in every walk of life, are watching eagerly for further developments in the experiments of Doctor Bancroft and Mr. Warren.

Public Was Skeptical

So many quacks have advanced theories and apparatus for making rain in the past century that scientists and the public have come to look askance at any attempts at rainmaking. But never before has a process been put forward with such reliable scientific backing.

A dramatic picture of one of the experiments carried out at McCook Field is drawn by Orville Wright, famous as a pioneer in aviation, an eyewitness.

"While at work in my office one day," he said, "my attention was attracted by the peculiarity of the sound of an airplane overhead. On looking out of the window I saw the plane just entering a dense white cumulus cloud. It completely disappeared from view, but 10 or 15 seconds later it emrged from the opposite side.

"When it emerged, I noticed it was leaving a long trail of what appeared to be smoke in its course, but on further observation, I discovered the trail was dust being discharged from beneath the airplane. I then recognized it as one of Doctor Warren's experiments, of which I had already heard.

"After the airplane had passed through the cloud five or six times, the cloud began to fade away, and at the end of three or four minutes had practically disappeared. The airplane then entered a cloud that was lying at the left of the first one. After the plane had passed through it several times, this cloud began to fade rapidly.

"The plane then flew to a third cloud. Within about ten minutes from the time I first saw the plane, the three clouds had entirely disappeared. I did not observe any precipitation while the clouds were disappearing."

Spraying cloud banks with electrified sand, the balloon cuts a path of clear atmosphere to earth

How Fog Is Dispelled

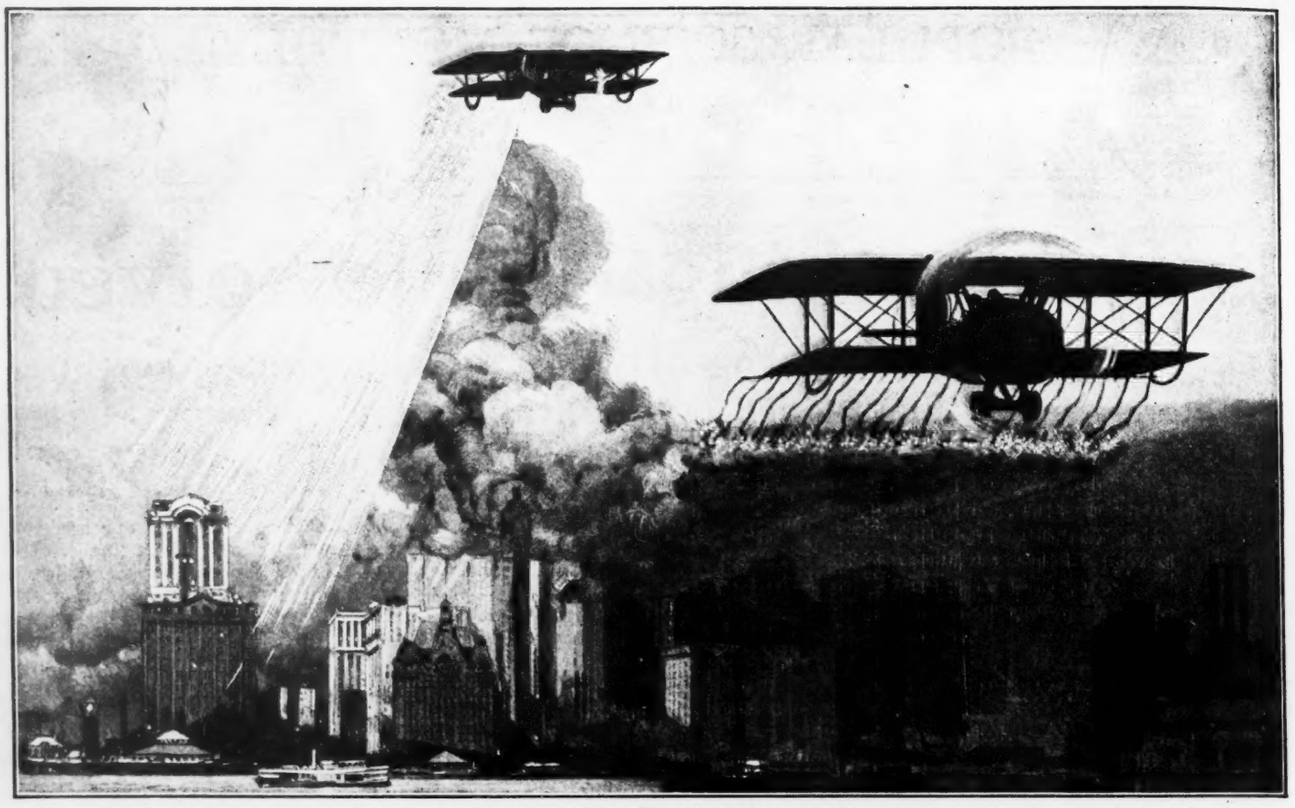
Within six months Bancroft and Warren expect to complete further experiments that will establish in the minds of the skeptical the practicability of their process beyond the shadow of a doubt.

The fog dispelling operation is comparatively simple. Briefly, pulverized sand is carried above the clouds by airplane, the sand is electrically charged as it issues from nozzles, and is sprayed on the cloud. The sand causes particles of moisture to coalesce, or combine, until the tiny drops form one big drop heavy enough to fall.

Doctor Bancroft explains that clouds consist of drops of water too small to fall under the pull of gravity.

Electrically Charged Sand

"Drops of moisture in the clouds are kept from coalescing either by being charged electrically and therefore repelling each other, or by being covered with a film of condensed air that acts like a gelatin capsule," he says. "Spraying with positively charged sand will cause negatively charged drops to combine and also will remove the film of air around the drop to some extent. The large drops fall and carry down with



How scientists propose to manufacture clouds and rainfall. The first plane, trailing sparking antennae, condenses the soot and moisture laden air into a cloud by scattering electric charges. The second plane turns this cloud into rain by spraying it with electrically charged sand

them many of the finer drops, just as the coarser particles of butter fat in milk carry up many of the finer ones when cream rises.

"The new process sprays electrically charged sand from above, and the thicker the cloud the more rain will be produced with the same amount of sand. Experiments at McCook Field show that with 80 pounds of sand charged to 15,000 volts, a cloud covering two square miles can be dissipated in less than ten minutes. Much better results are expected with sand charged to 30,000 volts and with a more efficient charging nozzle.

Captive Balloon Clears Flying Field

"Experiments so far have been made in cooperation with the Army Air Service to demonstrate the feasibility of removing fogs from flying fields. Experiments to be made at Moundsville, W. Va., will use a captive balloon 1000 feet up to spray sand and clear the field. Flying fields can certainly be kept clear and results look encouraging for clearing up New York and other harbors when necessary.

"Successful preliminary experiments have been made with smoke," continues Doctor Bancroft, "but nothing has been done with fogs containing smoke. The problem of removing London fogs seems much less visionary than it did one year ago and is now a question of efficiency.

"The clouds attacked so far have contained very little moisture. The problem of obtaining rain from heavy rain clouds should be much easier than dispersing fogs. No claim is now made that rain can be obtained from a clear sky. In many of the arid regions rain clouds pass over without raining. These can undoubtedly be made to rain."

Artificial precipitation was first accomplished in November, 1921, according to a statement made by Mr. Warren, when a flurry of snow followed the spraying of a cloud with charged sand. Since then a great many test flights have been made and no cloud has been able to resist the sand-blast attack made upon it.

In addition to dissipating existing clouds, the scientists hope to clear the atmosphere of large smoky cities. They propose to do this first by creating fog clouds by charging the moisture laden atmosphere with electricity and then using the sand blast to precipitate the clouds thus formed. To condense the foggy atmosphere into clouds they propose to produce negative charges in the atmosphere by means of electric sparks issuing from a multitude of wire antennae trailing from the plane. The ensuing process of dissipating the clouds so formed is by spraying the negatively charged droplets with positively charged sand, thus causing the two to combine and form huge drops.

If the process can be carried out on a large scale and cheaply, its great future will be economic. If it can water sections of the country threatened with drought, if it can make the desert bloom, the discovery may eventually change geography and history, remake the maps of the world and alter the future of the human race.

It may take its place as one of the greatest scientific discoveries in the history of the world, with effects as far-reaching even as the telephone, radio, the steam engine and the automobile.

Think what man-control of the weather will mean to the farmer! Visualize hundreds of airplanes flying high over parched sections of the country. The rain clouds that ordinarily would pass by, carrying their moisture with them, are attacked. Down comes the rain. Gasping acres receive it and millions of dollars are added to the value of the crops.

Think of the time to be saved by steamships entering our harbors. With sand-blasting airplanes cutting the fog away, these ships could make their docks without delay, saving enormous sums.

Consider a naval battle off our coasts with the safety of the nation depending on prompt action by our battleships. A fog comes rolling in from the sea. The big guns are powerless because their targets have been obscured. The airplanes with their charged sand hop off the decks of the ships and dispel the fog, revealing the enemy.

Would Drive Away the Gloom

Take an army, helpless in the field while fog-protected artillery bombards its positions. Airplanes again would come to the rescue, dispelling the fog and revealing the hidden guns.

Such a discovery has a psychological value—an application to every-day life.

How often have you experienced a feeling of depression on a gloomy, foggy day with its attending oppressive humidity? The day is dark, the air is close and you feel blue. Suddenly there is a whir overhead. The fog is collected into clouds. Then the sand is sprayed on them and before long it rains. The sun then comes out and you breathe a washed and cleansed air.

So far, experiments made by Bancroft and Warren have been highly successful, but thus far, of course, they are still experiments. However, they are planning other tests with heavier clouds for the next few months.

Mr. Warren has a theory that precipitation will be carried from cloud to cloud by a "trigger action," wherein electricity generated by the falling sand and rain will cause more to generate in adjacent clouds and thus set off the entire heavens, much in the manner of a long fuse. Doctor Bancroft doubts this theory, but the next big experiments will be carried out over the Atlantic as a safety precaution.

The Science of Laughter

An Interview with WILL ROGERS

THROUGHOUT the United States, Will Rogers, of the Ziegfeld Follies, is known for his genial wit. People seem to laugh spontaneously when he appears on the stage or the screen.

But here Mr. Wheeler sees the famous cowboy comedian in an entirely new role. He sees him not through the mask of comedy but as a sincere student of the mechanics of his business—the science of laughter.

By Edgar C. Wheeler

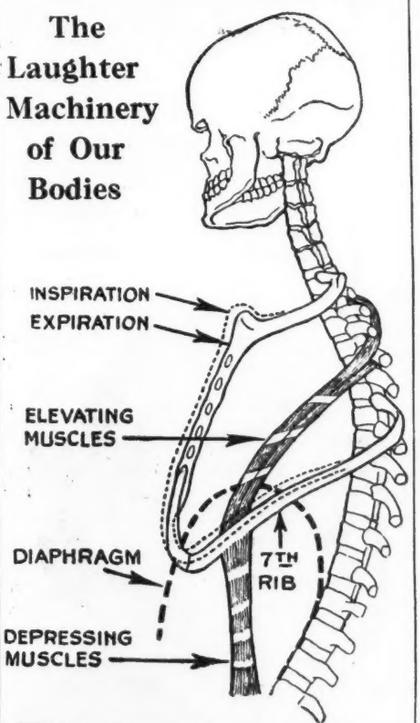
WHY should people laugh?

What makes us shake our bodies and emit strange noises when something strikes us funny? And what effect, if any, have these apparently unnecessary contortions on our bodily health, our mental well-being and our success?

I put these questions to Will Rogers—the gum-chewing, lariat-swinging Will of stage and screen, who probably has made more people laugh than any other man in America.

I found him sitting in his dressing room at "The Follies," surrounded by the picturesque paraphernalia of his profession—typical cowboy outfits hanging on the wall; a dozen neatly piled coils of rope of various lengths and thicknesses; a guitar standing in one corner. His jaws were working overtime, while his words dropped fluently between them.

The Laughter Machinery of Our Bodies



THIS diagram shows our bodily machinery of laughter. It consists chiefly of two sheets of muscles attached to the seventh rib—the longest and strongest of our ribs—and the large muscles called the diaphragm, as shown above

"Why should people laugh?" he repeated. "That's an easy one. People need to laugh to keep their minds and their bodies in good running order. It's a relaxation. It gives people a fresh start, with the slate wiped clean of past aches and worries, that is to say the physical and mental atmosphere is cleaned up.

"Everybody *should* laugh. But what I'd like to know is why some people *don't* laugh. Do you know there are hundreds and thousands of people in the world who never crack a smile? What I'd like to find out is how to make them laugh."

And right there I discovered that this boyish cowboy funmaker is an honest-to-goodness scientist, although he denies it—emphatically. He is a scientist in that he systematically studies the faces in his audiences to find out why they laugh and how to make them laugh.

And the most remarkable thing is that his conclusions corroborate in a valuable and practical way the most recent scientific theories.

The Effects of Laughter

Scientists now tell us that laughter is just one way of giving vent to emotions that have long been repressed. It causes this relief from depression in two ways—physical and mental. Physically it stimulates circulation, increases depth and rapidity of breathing, and drives more blood to the brain. These things bring us a feeling of well being.

Psychologically laughter interrupts gloomy trains of thought and morbid preoccupations. It uses up our reserve stores of energy, both muscular and nervous. It rebuilds worn cells in our systems. It relieves our nervous tension.

"Take that time in my career when I learned most about laughter," said Will. "It wasn't a Follies performance, it wasn't a banquet at the Waldorf, but it was when I went to Sing Sing Penitentiary.

"Usually I can tire out people in half an hour. But up at Sing Sing, when I spoke to the prisoners, I had to talk for a full hour and a half, and even then the men weren't satisfied.

"Why was this? I think it was partly because a criminal is a thorough newspaper reader. He knows what's going on and he's quick to catch a point. But more than anything, he's ready to laugh. He needs to laugh. A loud guffaw is a relief from his oppressive surroundings."

In other words, according to the new scientific theories, when the Sing Sing convicts laughed heartily at Will Rogers' jokes, they were simply exhausting much of the excess nervous energy that previously they had spent in brooding. Afterward, they were less discontented; had less nervous energy to spend on gloomy thoughts.

"Everybody *should* laugh. What I'd like to know is why some people *don't* laugh."—*Will Rogers*

The kind of things that makes us laugh—what we feel, or see, or hear—stimulate us to some sort of muscular activity, according to these theories. They do it by causing certain glands in our bodies to release substances into the system that stimulate us to action. We give vent to this need of action finally by bursting into laughter. The longer we are held in suspense, the more uncontrollable the discharge of emotion in laughter when the point of the joke releases us.

And now comes America's famous cowboy funmaker, whose one laboratory is the sea of faces, gay and sober, before him, to clinch all that science has found out about our bodily mechanism of laughter.

"What's your secret of making people laugh?" I asked him.

"Keep 'em guessing—that's the best bet. To get a joke over big, you've got to make your audience hold its breath in suspense while you lead them up to the point.

"The best humorist is the one who knows just when to suddenly open the safety valve of laughter. All of us have to experiment with a joke until we find the exact point where it goes biggest with the most people. I say 'most people,' because I don't know a single joke that will make everybody laugh."

Article published by arrangement with the McNaught Syndicate, Inc.

Man—An Animal Invention

How Worms, Fish, and Reptiles Helped Create the Complex Machinery of the Human Body

The third of the series, "The Story of Man and His World"

By E. E. Free, Ph.D.
Fellow American Association for the Advancement of Science
and
William K. Gregory, Ph.D.
Curator of Comparative Anatomy, American Museum of Natural History

A LIVING museum of the thousands of inventions devised by the striving creatures of past millions of years has been preserved for us inside the human body. It is a record of creation.

The bones are levers that move on self-oiling joints. The eye is a photographic camera, lens and all, and the sensitive plate inside it is so wonderful an invention that it renews itself continually and can photograph many images, one after the other, and accurately pass on each one of them to the brain. The digestive apparatus is an intricate and efficient power house equipped with a multitude of ingenious devices for getting the fuel value out of food. The heart is a self-regulating force pump. The voice is the most complete musical instrument ever devised.

All of these things and thousands of others like them were invented by our animal ancestors. Some of them originated with the tiny primeval speck of living slime that first learned to move itself about. Others came from the wormlike creature that tried to crawl against the currents of water and invented the backbone. Still others are the inventions of the progressive reptile, millions of years later, who devised a way of keeping his body warm.

Everything that we are, the very fiber of our being, was made and tested for us by these animal inventors—lowly and forgotten geniuses who lived long ago and each of whom left his little contribution to the progress of life.

In the animal line of evolution the first great invention was that of motion. Primeval specks of slime, floating about in the sea water, learned to move themselves.

COMPARE the two portraits below—the one an intellectual type of modern man, the other an early caveman.

Notice the highly developed brain of the former and the low flat forehead of the latter. The man of today has developed a brain immeasurably superior to his low-browed ancestors. Yet fundamental similarities between the two are apparent. There is no scientific doubt as to their relationship.

THE relationship of the caveman to apelike animals—his ancestors and ours alike—is just as firmly established. And while modern man owes much of what he is to the man of the ice ages, he owes still more in the perfection of this body machinery to long-forgotten animals still farther down the scale of evolution.

This animal heritage of man is here explained by two eminent and brilliant writers. They tell how the human body was invented piecemeal millions of years ago. They say that it is Nature's own patent office — a living museum of innumerable inventions devised by our animal ancestors through countless prehistoric ages.

They did this by inventing a new kind of living matter, a kind that could contract and make itself shorter. This tissue could change the shape of the slime speck or move its little tail about in the water and drag the speck along.

This power of tissue to contract is still the essential thing about all kinds of animal motion.

In our body we call such tissues muscles. When we raise our arm it is not because something has pushed it up. The muscles on top of the arm contract and *pull* it up. When we want to lower the arm again, the muscles on its under side contract and pull it down. The motion is lever-like, similar to that of a steam-shovel. Movement of muscles, no matter what it seems to be, is always a contraction.

Muscles are really bundles of tiny fibers laid together side by side like the fibers of a rope. Each little fiber has the power of contracting at the command of its control nerve. The contraction of all of the fibers shortens the muscle and does our work for us.

The great original invention, therefore, the invention that made all the later ones possible, was the invention of the muscle fiber.

Another great invention was that of bone, of something hard and solid to support the soft framework of the animal and to which the muscle fibers could be attached. Based on the same idea is the steel skeleton of the modern skyscrapers. It was a very long time before this next step was taken. Many animals never took it at all.

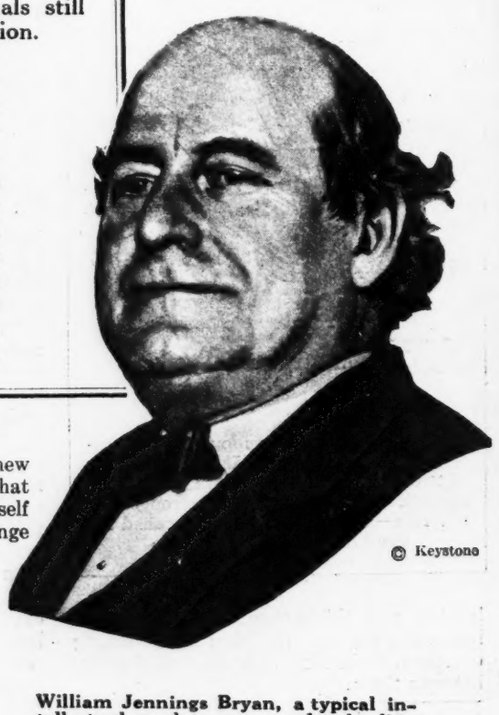
Bones Our Patent

For instance, the mollusks, like the clams and oysters, have no bones, only a hard shell on the outside of their bodies. Internal bones are an exclusive possession of our own group of animals, of the backboned animals or vertebrates. They were invented by one of our particular ancestors and we have held a patent on them to this day.

The most important part of this bony scaffolding is the backbone. In the beginning it was scarcely a bone at all, only a rod of hardened tissue running lengthwise of the animal. It was invented, scientists

Courtesy American Museum of Natural History

A brute man of the ice ages, known as Neanderthal man. He lived in the caves of Europe some 50,000 years ago

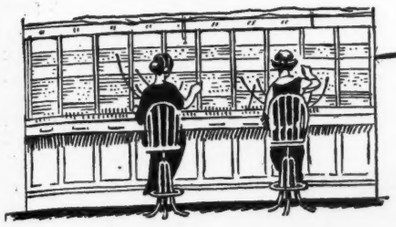


© Keystone

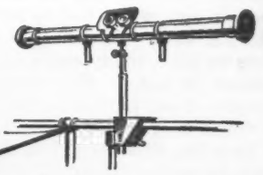
William Jennings Bryan, a typical intellectual modern man and a leading opponent of the theory of evolution

Your Body a Marvelous Machine

How Man's Inventions Are Equaled by Nature

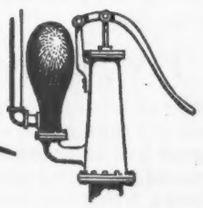


The brain is like a central telephone exchange



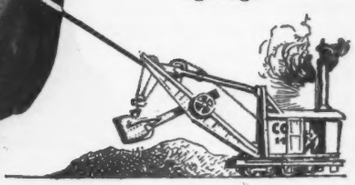
The double eye, performing the same function as a military rangefinder, is an invention found only in man and a few animals. The eyes of most animals are so placed that they do not have range-finding vision

To maintain an even temperature in the body, Nature invented an intricate system of control, like a thermostat, operating through the glands and skin

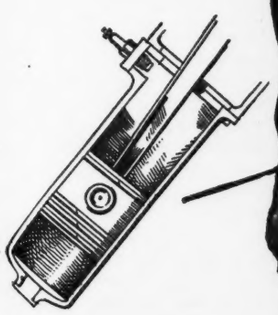


The most ingenious pumps ever perfected by man are far less marvelous than Nature's own invention, the heart, first devised by creatures in the sea countless ages ago

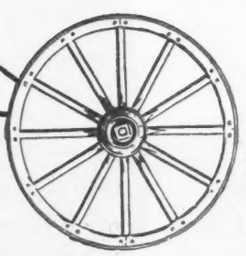
The steel framework of the skyscraper was preceded millions of years by Nature's own invention of the skeleton



Our animal ancestors invented the arm with a lever motion like a steam shovel



Our muscles, supplying the motive power for our bodies, are engines that work in a fashion comparable to this gas engine



The legs are nothing but two spokes of a wheel, moving back and forth instead of around, as they carry us forward. The wheel itself is one invention in which man has surpassed Nature

believe, along the seashore. Long before this, some little tubelike creatures, not very much longer than they were wide, had acquired the habit of clinging to the sea bottom by one end while the tide waved their bodies back and forth. Thus these creatures developed a difference between their two ends; one end clung to the bottom, while the other drifted freely in the water. This marked the invention of the head and tail.

The next step was that these creatures began to creep. Between the tides they would move slowly along the bottom, still holding fast by their head end, or perhaps fixing themselves anew after each little forward movement. Very slowly, generation after generation, they learned how to move when the tide was running as well as when it was still. They became creeping wormlike things that could crawl against the tide if it were not too strong, as well as move with it as the other drifters did.

Then began the invention of the backbone. A stiffened rod down the back was a great assistance even in crawling against the current. It was absolutely essential if these creatures were to take the next step and *swim* upstream against the current, not merely crawl against it along the bottom.

And so they developed a rod of gristle down the back, the predecessor of the backbone. They became a very primitive kind of fish.

Extensions of this great invention came rapidly. Other bones were developed in the fish body; bones to support the sides as the backbone was bent, other bones to stiffen and move the fins, so that swimming would be easier. The development of our complicated skeleton was well under way.

The next great invention came when the fish went ashore. It was the invention of legs.

In the meantime, of course, there had been the invention of blood, which we shall speak of presently, and of lungs, which enabled the fish to breathe air. Even before legs were thought of, the fish had become an amphibian, like the modern newt or salamander, equally at home in the water or in the air.

The art of breathing air had been

Neanderthal man. He lived in the caves of Europe some 50,000 years ago

tion.

In our body we call such

William Jennings Bryan, a typical intellectual modern man and a leading opponent of the theory of evolution

developed already by two or three other kinds of creatures; by some shrimplike water scorpions that evolved finally into insects, and perhaps by worms like the modern earthworm and by shelled creatures like the snail. Life has discovered, from time to time, many ways of breathing air instead of water. The lung way, the invention of our particular fishlike ancestors, is only one of them.

This fish, as we say, had come ashore, at least for part of the time. It could breathe water just as it had done always, or it could, when necessary, breathe air. But on land its movements were very sluggish. It still squirmed along the ground a good deal as it had been accustomed to squirm along through the water. It was even more clumsy than a modern seal is on the shore. This was no sort of equipment, obviously, for the conquest of the land.

Fishlike Creature Invents Legs

And so this fishlike amphibious creature made the third of the great inventions. It learned how to lift itself off the ground. It invented legs, two pairs of jointed crutches between which the body was slung, and which by moving back and forth could carry it along.

In the beginning its fins or flippers were used as oars in the water; they rubbed against the ground and helped to shove the prostrate body along. Gradually they got more strength; step by step they became able to lift the body off the ground. The fish became a reptile-like thing, running, somewhat sluggishly perhaps, on four legs.

Bones Found

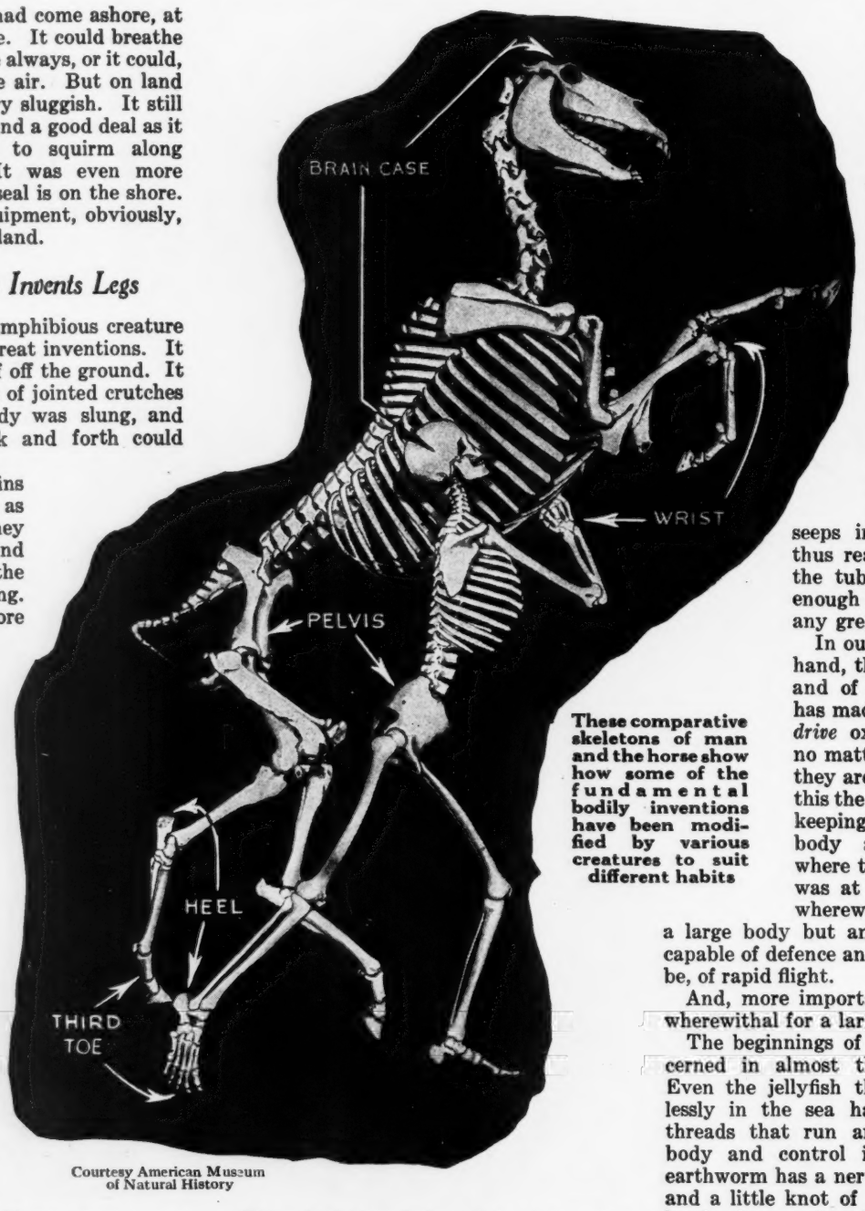
In the ancient rocks of Texas geologists have found the bones of a creature just in this stage; half a creeper pushed along by its flipper-like legs, half a runner using these legs as modern reptiles do.

And now we come much closer to our own time. About a hundred million years ago the world was in the age of reptiles. There were many thousand kinds of them, from tiny lizards similar to our modern ones, to the great beasts such as the Diplodoccus and the Brontosaurus, which weighed thirty or forty tons apiece. All these reptiles were cold-blooded, as are their survivors, the alligators, lizards and snakes of today. Most of them were smallbrained and uninventive. That is why they died out.

But one race of them did make an important invention, one of the most valuable that we enjoy. They invented warm blood.

This invention was much more important than it may seem at first sight. The energy of the body is chemical energy. It is produced by the burning of food. And like other engines run by fuel, the body works better and makes energy faster when it works at a higher temperature. It is like a steam engine using superheated steam.

The cold-blooded reptiles were handicapped by their low temperature. They could move rapidly only when the weather was warm. Every one knows how sluggish a snake is on a cold day. And so the reptiles that invented warm blood had a great advantage. They could move rapidly any time, in warm or cold weather. This was perhaps the greatest single step ever taken by life in escaping from slavery to climate.



Courtesy American Museum of Natural History

These comparative skeletons of man and the horse show how some of the fundamental bodily inventions have been modified by various creatures to suit different habits

There had been before this, of course, a necessary preliminary invention: the invention of blood. This we share with many other animals. It was made long ago in the sea. Probably it was originated and tested even before bones were developed. Certainly the fishes had it long before they came ashore. There had been invented, also, the devices of a force-pump heart and a system of elastic-walled arteries, by which the blood could be driven around through the body so as to supply oxygen and food materials to every little fiber of muscle and every little cell of nerve and brain.

This was necessary, let us remember, to any great increase of body size. In a great many of their characters some insects are more developed than human beings; they have gone farther along the path of evolution. But they have never become large. The largest of them, the great dragonflies of the coal age, were only about two feet across their full spread of wing. The effective size of the insect family seems to be three or four inches at most.

This small size has been always a great handicap to the insects. It has made them an easy prey to larger creatures. It has prevented long life and the acquirement of individual experience. It makes large brains impossible. It has doomed these creatures, very wonderfully organized in their way, to be slinkers and fugitives, to occupy the chinks of the world that larger creatures do not try to fill.

The Secret

And this difference of size has been due mainly to different ways of breathing. The insects have no blood. They breathe by means of a number of tiny air-filled tubes running through their bodies and connecting with the outside air. Air seeps into these tubes and thus reaches the tissues. If the tubes are too long, not enough air will get in, and so any great size is impossible.

In our family, on the other hand, the invention of blood and of the force-pump heart has made it possible for us to *drive* oxygen to the tissues, no matter how deeply buried they are. When we added to this the device of warm blood, keeping all the tissues of the body at the temperature where their chemical activity was at its best, we had the wherewithal to build not only a large body but an active one—a body capable of defence and of offence or, if need be, of rapid flight.

And, more important still, we had the wherewithal for a large and active brain.

The beginnings of the brain can be discerned in almost the earliest creatures. Even the jellyfish that floats about aimlessly in the sea has a ring of nervous threads that run around its bell-shaped body and control its movements. The earthworm has a nerve cord down its back and a little knot of nerve matter near its head; the promise of a brain.

But an actual brain, something capable of real thinking, was possible only when warm blood had been invented. The brains of the great cold-blooded reptiles were ridiculous little things no larger than the human fist, though the beasts themselves were 80 or 90 feet long.

Billions of Cells in Human Brain

Our brain, on the other hand, is a great group of many cells, nearly ten billion of them, closely packed together so that they can be in very intimate contact with each other. All these cells must be fed. They must be supplied with oxygen. If they are to do their best work, they must be kept at a constant temperature.

You see how important it was for us to have a forced circulation of warm blood well charged with oxygen. Without this

(*Continued on page 105*)

A Baby—An Open Safety Pin

How Doctor's Ingenuity Saved Child's Life

TWO looped wires. A tiny pair of pincers at the end of a third wire sheathed in a hollow tube. A tiny electric light bulb.

With these as his only tools, Dr. J. H. Buff, young throat specialist of Atlanta, Ga., recently succeeded in fishing an open safety pin from a baby's stomach without using knife or anesthetic.

This thrilling victory of science and ingenuity was won after other physicians had given up hope.

Missing—One Safety Pin

Early one morning, the mother of six-months-old Mac Asbill, Jr., had given the baby his bottle of milk and had put him back to bed, pinning the covers about him. A few minutes later, she heard the baby scream and picked him up. She noticed that one of the safety pins was gone.

After a vain search for the pin, she called a doctor. An X-ray revealed that the child had swallowed the safety pin, that the pin was open, and was lodged in the stomach with the sharp point and the safety catch upward near the throat entrance.

Doctor Buff was called in. After examining the X-ray pictures, he declared that he would extract the pin, and soon had prepared his ingenious instruments.

To the handle of a tiny pair of pincers he attached a wire 1½ feet long. At the end of two other wires of the same length he prepared small loops. One of these loops was to slip over the butt of the open pin, so that when the wire should be pulled upward, it would close the pin. The other loop was to slip over the pincer handles to tighten the grasp of the jaws as soon as they should catch the head of the pin. At the end of a fourth wire he attached an electroscope—a tiny electric light. Two handles like those of scissors were attached to the free ends of the wires controlling the pincers.

How the Job Was Done

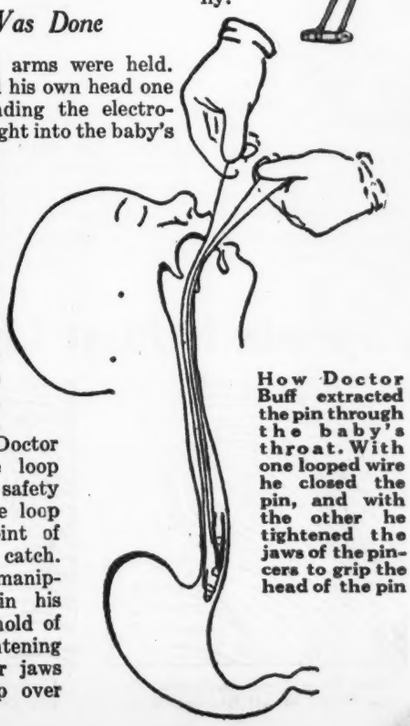
The child's head and arms were held. Doctor Buff fixed around his own head one end of the wire suspending the electroscope, then lowered the light into the baby's throat. In his right hand he held the handles of the two pincer wires and after slipping the loop over the pincer jaws, carefully inserted the tool and wires into the baby's throat to the point where the throat enters the stomach. In his left hand he held the second looped wire, which he alse inserted.

With his left hand, Doctor Buff slipped this wire loop over the butt end of the safety pin, and by pulling the loop upward, forced the point of the pin toward the catch. Then, with the pincers manipulated by the wires in his right hand, he caught hold of the head of the pin, tightening the grasp of the pincer jaws by pulling the loop up over the handles. A few careful manipulations and the pin point was safe in its catch, and the closed safety pin was withdrawn from the child's stomach. The young throat specialist's ingenuity, skill, and nerve had saved the baby's life.

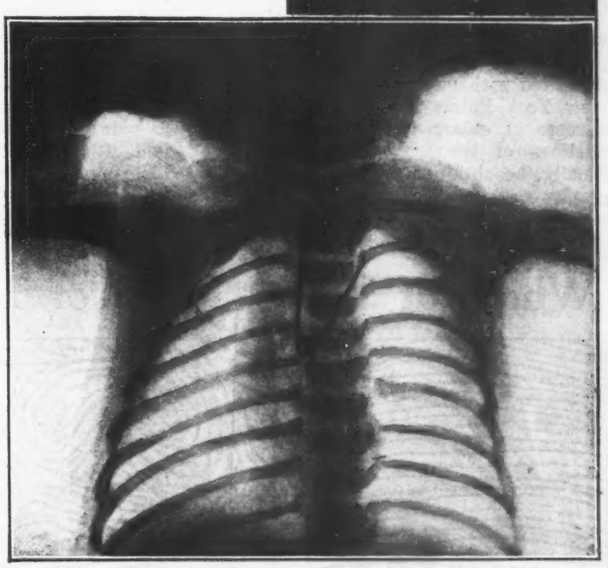
It was an operation that required the utmost speed and precision to prevent the baby from choking. At one point in the manipulations, when the child's breathing became difficult, the apparatus had to be withdrawn temporarily.

Baby Mac Asbill, who swallowed the open safety pin and survived

Dr. J. H. Buff, who saved the baby's life, and the hastily improvised apparatus of looped wires and pincers with which he closed the safety pin and drew it from the child's stomach



How Doctor Buff extracted the pin through the baby's throat. With one looped wire he closed the pin, and with the other he tightened the jaws of the pincers to grip the head of the pin



This X-ray photograph revealed the position of the open safety pin close to Baby Mac's stomach, with point pricking upward. It was this photograph that guided Doctor Buff in the delicate manipulations by which he closed the pin and grasped it with pincers

Artists' Thumbprints to Identify Paintings

LIKE the climax of a fantastic detective story is the latest achievement of science in comparing fingerprints to identify as a real Da Vinci an age-worn canvas, recently bought by a New York collector of art.

The question whether a certain painting is the original work of a great master can now be determined absolutely, simply by examining the painting for fingerprints left on the canvas by the artist and comparing these with fingerprints found on paintings known to be originals. Signatures can and have been duplicated. Fingerprints cannot be forged.

When George T. Pearsons of New York last year acquired two rare old paintings, the restoration of one of them, believed to be of comparatively little worth, revealed qualities that at once identified it as the work of a master.

"From what I could judge," said Pearsons, "the painting was a Gianpetrino. But the restorer, who had worked on many famous old paintings, expressed to me in confidence the belief that it might be the work of Leonardo Da Vinci, one of the old masters.

"Finally, one day there came to my office Arthur Sowaal, fingerprint expert and artist. While he was talking to me, his attention suddenly became focused on the painting hanging in my office.

"Examining the canvas through a magnifying glass, he discovered that in the pigment of the painting appeared several fingerprints of an unusual nature. All of them were of the plain arch type—a fingerprint type characteristic of only five per cent of all persons who have recorded the swirling lines of their fingertips. And on all of them appeared two well defined scars.

Arthur Sowaal, fingerprint expert photographing Da Vinci's thumbprints that proved the painting of Saint John to be a 400-year-old masterpiece, worth its weight in gold

"Then began a series of remarkable demonstrations of the accuracy of fingerprint records, which finally confirmed my painting as a real Da Vinci.

"Sowaal's first move was to photograph with his fingerprint camera all of the fingerprints he found on my canvas. These he deposited with me. Then he went to the New York Public Library and examined a score of enlarged photographic reproductions of the works of old masters. Finally, he obtained permission to photograph certain finger-marked sections of reproductions of Da Vinci paintings.

"The fingerprints were calibrated with delicate instruments and compared with such care, that they proved the same hand executed all of them.

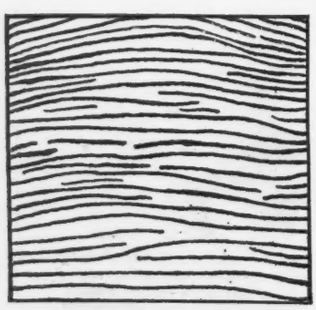
"For final, clinching evidence, the fingerprints on my painting were compared with those found on Da Vinci's 'Virgin of the Rocks' in the National Gallery, London.

"Da Vinci, who was a sculptor as well as painter, used his left hand in painting and often obtained the desired result on his canvas by impressing his finger on the moist pigment. Often, his paintings show, he made a long, sweeping movement with his right thumb to produce a shadow."

"The scar on the Da Vinci fingerprint is an elongated figure eight or double circle. The proof is molded in the paint and as long as the pictures exist, just so long will the evidence remain," says Sowaal.

There is other evidence, further substantiating Sowaal's findings. In 1510, Morelli, a contemporary of Da Vinci, pointed out to a group of friends that Da Vinci used his finger in painting. Further, it is recorded that when Da Vinci was urged to sign his masterpieces he proudly replied: "My marks are all over my work."

Which of These Types of Fingerprints Is Most Like Yours?



Da Vinci's fingerprint is of this rare arch type

Accidental type — another exceptional formation

The loop type includes 30 per cent of all fingerprints

Common whorl type—60 per cent of all fingerprints

Is Milk the Perfect Food?

"Yes," Says 100 per Cent Schoolboy—He Drinks Four Quarts a Day

John Boynton, New York's "most perfect schoolboy," rated 100 per cent in physique

Four quarts of milk a day pulled him up from sickliness to perfect health

"WHAT do you eat?" physicians asked John Boynton, 18, after they had examined him recently and found him to be the most physically perfect of all New York City schoolboys.

"Well, I drink mostly," John began; "I drink four quarts of milk a day."

And right there this "perfect boy" supplied the answer to a question that has stirred physicians and scientists to controversy for years:

Is milk the perfect food?

When John was five years old his parents despaired of his life. Physicians offered little hope that he would grow up to be a strong, healthy boy. They put him on a diet of regular sleep, recreation—and milk. Today he has passed, with a score of 100 per cent, the rigid physical tests that were part of a campaign by New York health authorities to improve health standards by finding what boy was most physically fit.

What Milk Did for One Boy

Today his bodily mechanism is without flaw. His posture is perfect. He can chin himself 12 times; he can jump 8.8 feet from a standing position; he can throw 10 basketball goals in 30 seconds; his chest, inflated, measures 38 inches; his left arm measures 12½ inches at biceps and 10½ inches at forearm. His hips are a "perfect 36." He stands five feet nine inches high and weighs 152 pounds.

As a 100 per cent boy of 18, John Boynton has advanced a long, long way from the puny, sickly child.

"Milk did it," he told his examiners. "Milk combined with meat in sparing quantities, some cereals, vegetables of all kinds, some fruit, and no sweets.

"For breakfast," he continued, "I drink a great deal of milk and eat a bowl of cereal. Rarely I eat an egg.

"For lunch I usually drink a pint of milk and eat a salad of fruit and lettuce. Or, for variety, I eat sandwiches instead of the salad.

"For dinner I eat an ordinary portion of meat, salad, vegetables, and three glasses of milk.

"My only planned exercise is to lie flat on the floor, face downward, every morning and lift my weight by my arms until I am tired. Then I take a bath. This I do regularly. The rest of my exercise consists of the seasonal sports at school."

Will Milk Help Every Person?

But can any person gain in physique and health by drinking four quarts of milk a day?

Scientists who have studied the question agree that a quart of milk contains as much protein as half a pound of sirloin steak, six ounces of round steak, or 4.3 eggs. In energy value, a quart of milk yields as much as 11.3 ounces of sirloin steak, 14.9 ounces of round steak, or nine eggs.

Yet recent investigations by the United States Department of Agriculture seem to show that the nutrition value of milk depends somewhat on the person's ability to digest milk.

"Although milk contains all the ingredients necessary for the building and repair of the body and for supplying energy for the body's activities," the report says, "the ingredients are so diluted with water that a large quantity (five or six quarts each day) is needed to meet completely the needs of an adult. The chief value of milk is in combination with other foods."

"To Keep Well,

"Drink more milk and keep well!"

That's the advice government and city health authorities are offering American families.

And the United States *is* drinking more milk. In the past 10 years milk drinking has increased nearly 17 per cent. Every man, woman, and child is now consuming about seven tenths

Drink Milk"

of a pint a day, as against six tenths of a pint 10 years ago.

But even this is not enough. Health experts say that every child up to the age of six should have at least a quart a day; that every child from six to 14 should have a pint, and that every adult should drink at least a half pint daily. This is a minimum requirement.

Jack Binns, world's most popular writer on radio, contributing exclusively to Popular Science Monthly

Our Radio Editor Announces

A New Broadcasting Plan

Radio Is Drifting to Destruction, He Says— National Supervision Necessary as a Cure

By Jack Binns

A YEAR ago I was talking in these columns about the magnificent future of radio broadcasting. Today I am forced to ask whether it isn't going to drift rapidly toward destruction, unless we all get together and see that something is promptly done to save it.

More than 600 radio stations have been licensed by the government to broadcast on the 360-meter wave length. At least 500 of these stations are likely to be a nuisance to radio fans and should never have been licensed at all.

The Wreckers of Radio Utility

Publicity seekers are nightly disturbing the ether with worthless talk that interrupts really good radio programs.

Business concerns are doing unwelcome advertising by radio, and filling up the intervals in their programs with canned jazz that is equally unwelcome.

Expensive broadcasting stations have lately been installed in the heart of great cities, only to prove unworkable on the wave lengths they are forced to use at present.

Most of the best entertainers won't talk for the public by radio because the broadcasting stations can't afford to pay them.

Through their own cupidity and jealousy, the great commercial groups identified with radio now seem just as likely to wreck the new utility as to extend its blessings.

Signs of Approaching Chaos

Conditions like these—signs of approaching chaos in the industry—are known to every radio fan in the country. And the worst of it is that the muddle is becoming greater at the very time when popular interest in radio has reached a higher pitch than at any time since broadcasting began.

What is to be done about it all?

The answer to that question is directly up to the radio fan. There is now pending in Congress the White Bill, to regulate radio and develop broadcasting. It furnishes the groundwork for the only kind of organization that will save radio. Now is the time for radio fans to declare unmistakably what they want this organization to be like, and I for one want to put forward a scheme that I believe to be feasible.

I propose a national radio plan that combines government supervision and subsidy with private operation. One of the fundamentals of the plan is a project for painless taxation, by which purchasers of radio sets would help meet broadcasting expenses. The operation of a large broadcasting station costs approximately $20,000 a month. That cost is being charged up to you indirectly today. It is included in the price you pay for radio apparatus.

Now if the government imposed a small percentage tax on all radio products sold, a considerable sum would be collected each year, with part of which the government could support the worthwhile radio programs. The cost of collecting the tax would go to the government, and after all governmental expenses had been defrayed, the balance could be applied in the form of a subsidy to the approved broadcasting stations, so long as they presented programs which came up to the accepted standard and were free from advertising.

Great Britain has successfully adopted such a scheme. A single operating company is formed of representatives of all radio concerns. The broadcasting stations are eight in all, geographically placed, and each operating on a different wave length.

Every fan must get a government license to receive. This costs him $2.50. The government gets half of this and the broadcasting company the other half. There is no confusion or advertising in the British system. The fan is protected.

In the United States, government control would be exercised by means of the power lodged in the Secretary of Commerce through the provisions of the White Bill. Unnecessary stations would be discontinued. Control of the programs would be vested in an advisory committee.

For Programs of High Quality

Under this plan, the world's best entertainers could be paid for their performances, and consequently programs of the highest quality could be planned satisfactorily in advance.

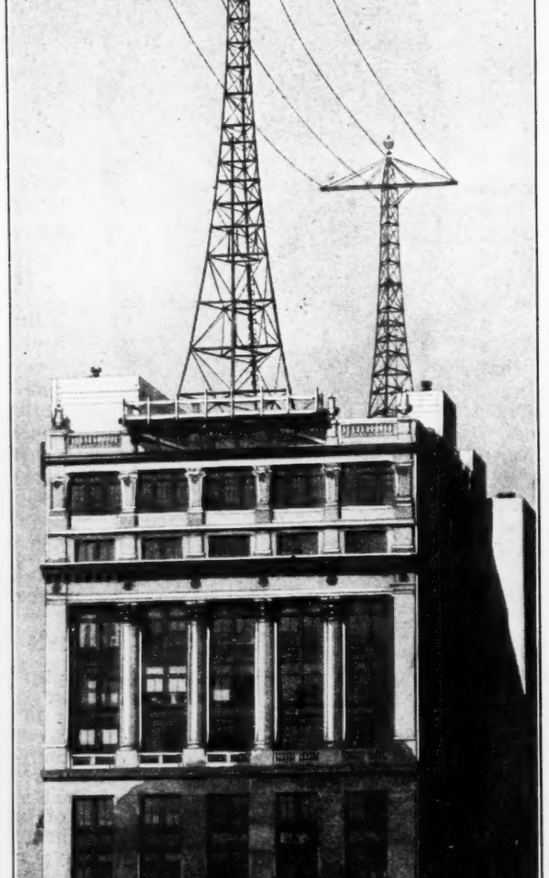
Personally, I think the ideal national broadcasting system would have two central studios, one at Washington, D. C., and the other in New York. The former could be used to broadcast the President's messages, the more important sessions of Congress, and vital national information of all kinds. Since New York is certainly the amusement center of the nation, the very best form of musical program, ranging from jazz to classics, could be broadcasted from there. All of the major broadcast stations, strategically located throughout the country, could be connected with these central studios by means of transcontinental telephone lines. Thus the entire nation could hear important addresses at the same time, while two or three programs could be radiated from the larger stations simultaneously on different wave lengths.

Problems to Be Met

By assigning larger wave lengths to the big central stations, many current radio difficulties would be solved. A queer problem that has just developed is the difficulty of broadcasting from stations located in the heart of big cities.

In New York City the skyscrapers in the downtown section loom up like mountains of steel and shield the territory behind them from reception of the short waves allowed for broadcasting. A station was erected on the Municipal Building six months ago. This building is almost 500 feet high. It was found practically impossible to radiate on the 360 or 400 meter wave length because of the absorption effect of the steelwork in the building. As the longer wave lengths are not allowed under the present laws, the station had to be removed.

Public demand for the passage of the White Bill, and for the development of radio, perhaps along some such lines as I have suggested above, will alone save broadcasting.



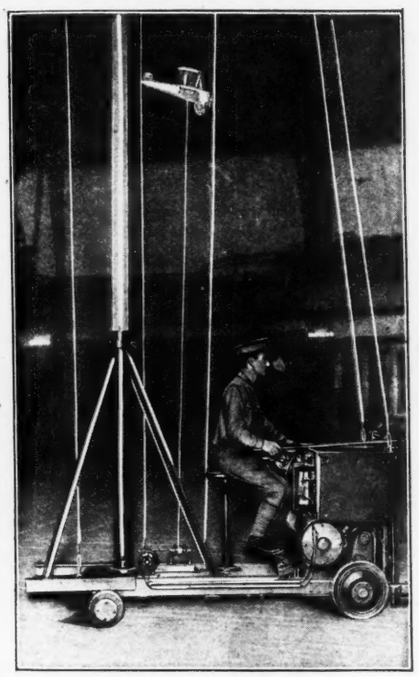
WILL this long-awaited new broadcasting station be a failure? Installed on top of a New York skyscraper, in the heart of the theatrical district, this great broadcasting plant of the Radio Corporation may prove unworkable, Jack Binns says, on present wave lengths. Government regulation, permitting longer wave lengths, would save such enterprises, he believes

Miniature Moving Airplane Trains Army Gunners

TO TRAIN anti-aircraft gunners in sighting a moving airplane, an American army officer has designed an indoor moving target that duplicates actual wartime conditions.

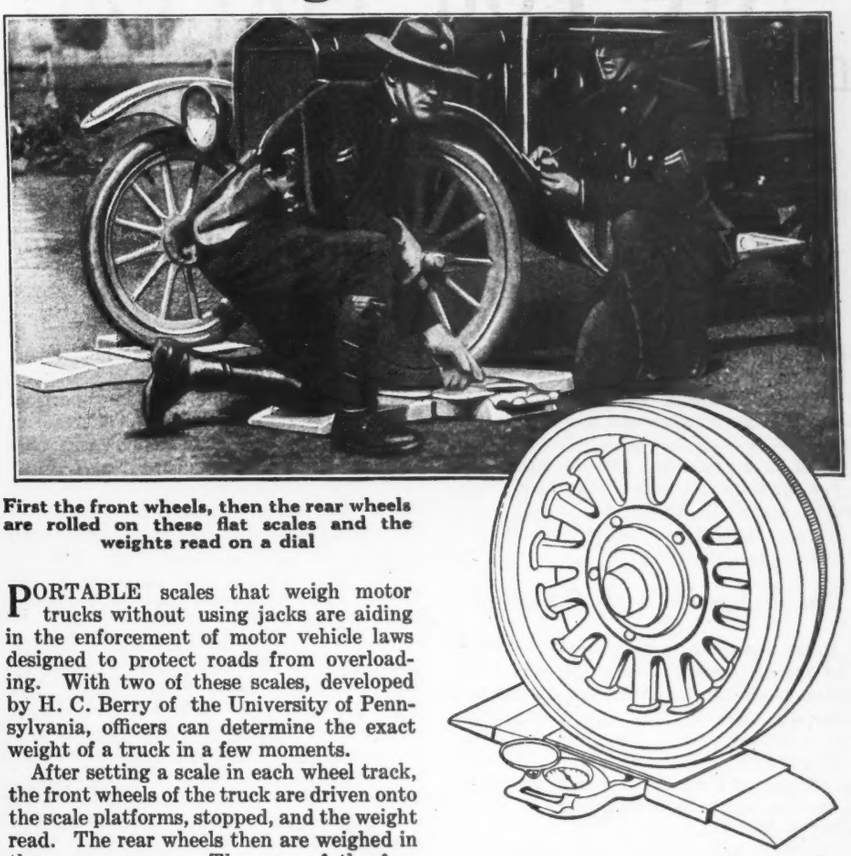
From the top of a 30-foot pole, mounted on an electrically dr ven truck, are suspended a series of wires along which a miniature airplane can be made to move up and down by the truck operator.

The truck is driven around the floor of an armory, while the plane is raised and lowered. Meanwhile, the gunners at their sights follow the searchlight-illuminated target, just as they would if operating against actual planes in wartime



The operator raises and lowers a miniature airplane while the truck moves

Autos Weighed without Jacks



First the front wheels, then the rear wheels are rolled on these flat scales and the weights read on a dial

PORTABLE scales that weigh motor trucks without using jacks are aiding in the enforcement of motor vehicle laws designed to protect roads from overloading. With two of these scales, developed by H. C. Berry of the University of Pennsylvania, officers can determine the exact weight of a truck in a few moments.

After setting a scale in each wheel track, the front wheels of the truck are driven onto the scale platforms, stopped, and the weight read. The rear wheels then are weighed in the same manner. The sum of the four readings is the weight of the truck.

The capacity of the scale is 15,000 pounds. The scale itself weighs only 80 pounds. With the approach blocks and steel plate used under the scale to permit the quick adjustment to different wheel treads, the scale may be packed in a case 18 by seven by 30 inches. Two cases may be carried easily in the tonneau of a small car, making it easy for officers to transport the scales from place to place.

Linemen's Gloves Tested under 10,000 Volts

TO ELIMINATE the danger resulting from slight leakages in rubber insulating gloves worn by linemen, a public utility concern of Baltimore tests all gloves under high tension once a week.

This apparatus detects any leakage

In the company's laboratory, the gloves are first inspected inside and out for defects. Then they are filled nearly full of a salt solution, and are immersed in a similar solution to a corresponding depth. The inner solution is then connected with one terminal of a high voltage system, while the other terminal is grounded. The voltage is gradually brought up to 10,000 volts in the case of new gloves, and 9000 in the case of used gloves, remaining on for a minute.

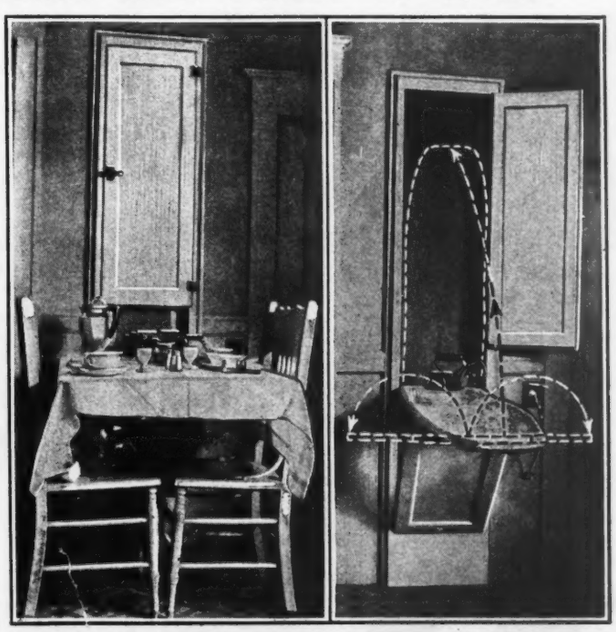
Any current that passes through the glove into the outer solution indicates a leakage.

Ironingboard and Table in Wall

A RECENT development along the line of economizing space in the kitchen is a combination ironingboard and table that disappears into a built-in cabinet between studding. The cabinet occupies a space in the wall 14 inches wide, 82 inches high, and 3½ inches deep.

When lowered into position, with leaves unfolded, the table measures 22 by 36 inches. The ironingboard may be swung down on the folded table leaves for support.

The lower panel of the cabinet swings outward to form the support for the table. A small compartment in the top of the cabinet may be used for storing small utensils.



At left: The table swung down, with leaves unfolded. At right: The ironingboard rests on the folded leaves

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

Are You Too Fat?

Better Be Underweight than Over, Says Famous Medical Scientist, Who Tells How to Exercise and Diet to Grow Thin

Chances for Long Life 3 to 1 against Stout Man Declares Dr. Eugene Lyman Fisk

HAVE you stood recently on a public scale, scanning the printed table telling you how much you should weigh at a certain age and certain height?

And have you felt a glow of satisfaction when the indicator swung round to a figure corresponding to, or just a bit beyond, the "average weight," supposed to be the "correct weight" for you?

The Average Person Is Overweight

If so, your satisfaction was premature. The average person is *overweight*—and that means he is far more subject to disease, especially after 40, than is the individual who is actually under the average figure.

So says Dr. Eugene Lyman Fisk, medical director of the Life Extension Institute, in an exclusive interview for POPULAR SCIENCE MONTHLY.

"Medical science has long known the bad effects of overweight," says Doctor Fisk. "But only recently have we discovered by an analysis of insurance and army records that the 'average' person does not stand the best chance of living long. In fact, the man or woman who weighs 20 or 30 per cent below the average has the best chance for long life at most of the ages after early adult life.

"Up to the age of 30 it does little harm to be overweight, as long as that weight does not reach serious proportions; but after 30 there is an increasing danger in overweight, and an increasing advantage in being slightly underweight. It is safe to say that the average individual reaches the ideal build at 30. If he can keep near that build for the rest of his life, he increases his chances of longevity. After 40, life insurance records show, the danger in overweight increases alarmingly, especially if the excess weight consists of fat, as in cases of excessive girth.

Watch Your Waistline!

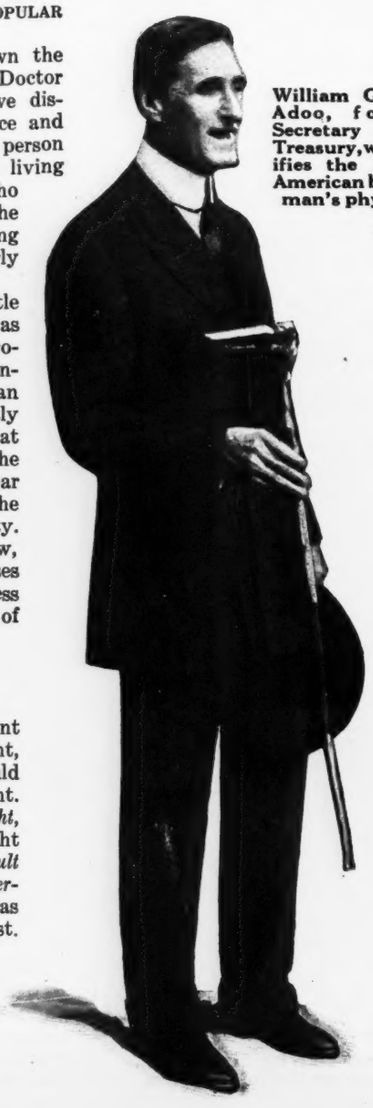
"In general, chest measurement should equal at least half the height, and the girth of the waistline should never exceed the chest measurement. *The average individual's overweight*, although it may reflect some slight influence of glands, *is largely the result of too much food and not enough exercise*. Excess food is accumulated as fatty tissue, usually around the waist.

"The average man or woman at rest requires between 1600 and 1700 food calories of heat. Moderate activity adds from 500 to 1000 calories to this requirement. Therefore, if the body is getting more than this amount, the result is too much fat. Every person should know something about the calory values of food. Ordinary portions of food contain about 100 calories—for example, one egg, a small glass of milk, or a moderate helping of roast beef.

"Yet a chocolate ice cream soda contains the same number of calories as a meal of fish cakes, bread and butter, and macaroni. Lean meat and non-fatty fish are not highly fat forming. An appetizing diet that is not fat forming may be based on these articles of food:

"Eggs, meat, fish, fowl, soups, green vegetables of all kinds, most fruits, potatoes in moderate amounts, buttermilk, tea, and coffee.

"Cereals, bread, and cake should be taken only in limited



William G. McAdoo, former Secretary of the Treasury, who typifies the average American business man's physique.

What chance has the fat man, compared with the slim man, in the race of life? These illustrations, based on "idealized" life expectation records of life insurance companies, show that slim men can hope to live longer. The men above are 30 pounds under average weight; those on page 41, 30 pounds overweight. Starting at the age of 30,

Here's the Ideal Weight for You

(Weight at age 30 for various heights)

MEN		WOMEN	
5 ft.	126 lbs.	4 ft. 8 in.	112 lbs.
5 ft. 1 in.	128 lbs.	4 ft. 9 in.	114 lbs.
5 ft. 2 in.	130 lbs.	4 ft. 10 in.	116 lbs.
5 ft. 3 in.	133 lbs.	4 ft. 11 in.	118 lbs.
5 ft. 4 in.	136 lbs.	5 ft.	120 lbs.
5 ft. 5 in.	140 lbs.	5 ft. 1 in.	122 lbs.
5 ft. 6 in.	144 lbs.	5 ft. 2 in.	124 lbs.
5 ft. 7 in.	148 lbs.	5 ft. 3 in.	127 lbs.
5 ft. 8 in.	152 lbs.	5 ft. 4 in.	131 lbs.
5 ft. 9 in.	156 lbs.	5 ft. 5 in.	134 lbs.
5 ft. 10 in.	161 lbs.	5 ft. 6 in.	138 lbs.
5 ft. 11 in.	166 lbs.	5 ft. 7 in.	142 lbs.
6 ft.	172 lbs.	5 ft. 8 in.	146 lbs.
6 ft. 1 in.	178 lbs.	5 ft. 9 in.	150 lbs.
6 ft. 2 in.	184 lbs.	5 ft. 10 in.	154 lbs.
6 ft. 3 in.	190 lbs.	5 ft. 11 in.	157 lbs.
6 ft. 4 in.	196 lbs.	6 ft.	161 lbs.

each group contains 10 men. At 40, each group has lost one. At 60, three more fat men have dropped out, while the slim men hold their own. At 70, half the underweights are left; the overweights are reduced to three. Crossing the line at 80, three of the original 10 slim men are left, while only one lone fat man out of 10 reaches the tape

amounts by those who wish to reduce weight. Butter, fatty portions of meat, salad oil, cream, and nuts, contain large amounts of fat. Starchy foods, especially breadstuffs and pastry, are fat producers, while sugars and sweets of all kinds are *pure* fuel.

"What happens, of course, when we begin to get overweight is that each added pound makes us less likely to exercise and each decrease in exercise results in more fat. The reason of the influence of overweight on mortality tables is that an excess burden is laid upon the liver, heart, and kidneys; there is faulty elimination and a tendency toward fatty degeneration of the organs. Lack of exercise brings in its train muscular degeneration, faulty cell activity, and toxic conditions. High blood pressure is common among overweights.

"There are two good methods of cutting down weight—by exercising and by diet. Neither is perfect alone.

"The average system for weight reduction by exercise is illogical. More reliance must be placed on diet than on exercise. Remember that eight hours of steady walking serves to burn up only four ounces of fat, while the results from cutting down even a small part of the fat-forming food is almost immediate. In other words, it is best to cut down the weight gradually by increasingly strenuous diet and to increase exercise by slow degrees. It is positively dangerous for the very fat person, especially at middle life, to plunge into heavy exercise.

"One reason why overweights have difficulty in reducing is that as the weight decreases there is often a feeling of goneness that drives them to eat too much. The remedy is a harmless between-meal indulgence such as a cup of beef bouillon.

"Very often, physically lazy people who rely on diet alone to decrease weight, suffer from a flabbiness of the muscular tissues and this, of course, is harmful. Nitrogen material lacking in non-fat-forming foods and necessary for the muscular tissue must be supplied by proteins from eggs, milk, meat, or flesh food free from fatty oils.

"Weight reduction is an extremely important matter, as the statistics of life insurance companies show. And, in general, you may be sure that *in watching your waistline, you watch your health.*"

The champion fat man of public life—Ex-President William H. Taft

Hooligan Fish Burn as Candles

HAVE you ever used a fish for a candle?

Probably not, unless you have spent some time in the Far North or on the northern Pacific Coast. But the Alaskan "sourdough" will tell you that the finest food fish in the world may be lighted and burned—tail up—just like a candle.

One of the most picturesque industries in Alaska is the harvesting of this unusual smeltlike fish, called variously "hooligan," "oolican," "hollican," and "candle," but correctly termed "eulachon," which is Siwash Indian for candle.

Now, picture to yourself a clear, glacial stream winding through hills topped by rugged white mountains. On the mossy river banks at every bend of the stream rise plumes of smoke, marking Siwash encampments.

Each camp is a scene of intense activity. In dugout log canoes at the water's edge Indians wield scoop nets, bailing up the silver horde of "hooligan" fish from the choked river. Farther up the river bank boys tend huge log fires that have been built upon rock piles. Close to the fires are deep trenchlike pits to which squaws and children carry baskets of fish.

Rendering Out the Oil

When the first pits are filled, the work of rendering out the oil—a task that falls to the old men—begins. Across the waist of a canoe that has been thoroughly cleaned, a cradle of sticks is laid, and on the cradle are placed heated rocks from the fire. The fat fish, placed on the hot rocks, give up their oil, which drips down into the canoe.

When a canoe has been filled, the "hooligan" oil is allowed to cool, and takes on the consistency of lard. This is then stored in skins, crocks, or other utensils, where it keeps indefinitely.

The "hooligan" is a relative of the smelt and a distant cousin of the salmon. Like the salmon, it goes up the rivers to spawn, dying when it has reproduced itself.

Many Alaska miners have used the dried fish for candles, and the Indians prize it for cooking. When flavored with wild berries, it makes a delectable dish.

How the "hooligan" fish is turned into a candle. The dried fish is impaled on a stick and the tail is lighted

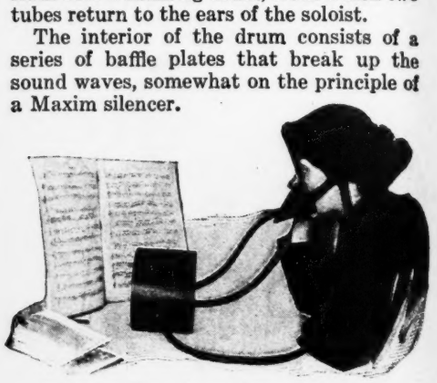
At left: Rendering the oil. Across the canoe is laid a cradle of sticks supporting heated rocks. As the fish sizzle on the rocks, the oil drips down into the canoe

Apartment House Soprano Wears Muffler Muzzle

ANY aspirant for grand opera who must practise scales will retain the love of neighbors by wearing a light song-silencer that will not spoil the volume or tone.

The singer is the only person who hears a sound. From the mouthpiece a tube leads into a muffling drum, from which two tubes return to the ears of the soloist.

The interior of the drum consists of a series of baffle plates that break up the sound waves, somewhat on the principle of a Maxim silencer.



This muffling drum drowns the voice

Artificial Light Tests Ink

VIOLET carbon arc lights, long used to test the resistance of clothing to the fading action of the sunlight, are now being used to determine how long the ink used on billboard posters will withstand the action of the sun. A poster is expected to withstand the weather for 30 days.

In 42 hours a new testing device gives the equivalent of a month's exposure to midsummer sun. The arc is in the center of the cylindrical container, and 40 samples of lithographic ink are placed in the little windows around the circumference. Half the sample is exposed, and the other half protected from the light by a metal shade. Special carbon rods impregnated with a secret chemical formula give the light of this arc fading qualities exactly similar to sunlight, although greatly intensified.

Testing samples of ink by arc light

Martyrs of the Speedway

"ANOTHER racing driver killed!" Behind that newspaper headline is hidden the true story of automobile development—a story to be told for the first time in the June POPULAR SCIENCE MONTHLY.

It is a story of mangled bodies of racing drivers—mileposts on the road to automobile perfection. It tells of that progress that demands sacrifice.

Place your order for the June number with your newsdealer today.

Is Water Cooling for Autos Out of Date?

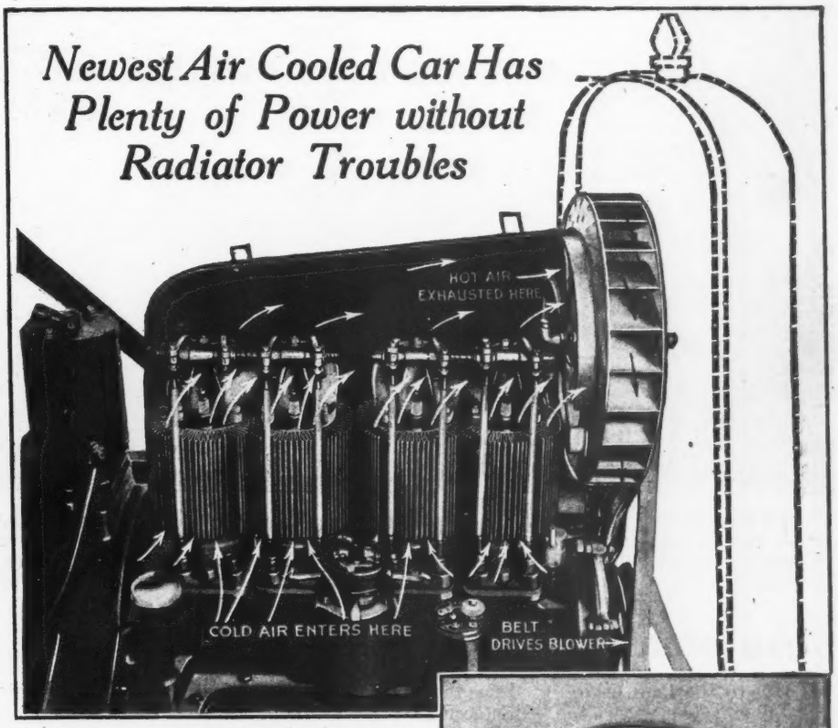
By Harold F. Blanchard

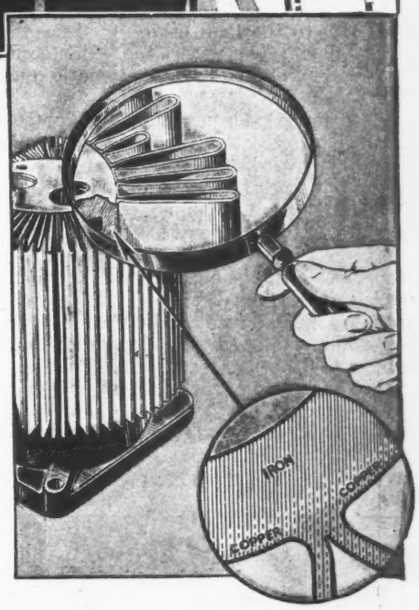
THE air cooled automobile engine is coming into its own.

Today it is safe to predict that a large percentage of cars of the future will be air cooled rather than water cooled—a prediction that is well borne out by the success of the newest air cooled car on the market, put out by one of America's foremost automobile manufacturers.

Compared with the water cooled engine offered with the same chassis by the manufacturers, the new engine has proved that it runs faster and develops more power. And the capacity of the cooling system for dispensing heat is fully as great.

Newest Air Cooled Car Has Plenty of Power without Radiator Troubles





Above: Improved air cooling system as applied to one of America's most popular cars, showing how blower fan at the front of the engine sucks cold air through looped copper cooling fins welded to cast iron cylinder walls, as pictured at right

Advantages of Air Cooling

Another important factor in predicting the future is that the air cooled machine is winning its way into popular favor. It is simpler, lighter, more economical than its water cooled brother, and it is free from cooling troubles. It can't be overheated in summer nor frozen in winter.

This trend toward air cooling is largely due to the success of one persistent manufacturer of a well known air cooled car, who has proved, year by year, that air cooling need not necessarily mean freakishness. Repeated public tests have demonstrated that his air cooling system would stand abuse to an extent that would spell ruin to any water cooled engine. A hundred miles at full speed in low gear has become a somewhat commonplace demonstration for the car.

Not long ago another successful air cooled car was introduced—a high grade, six-cylinder machine with low, smart lines and the equal, in appearance and performance, of any water cooled machine.

Air-Jacketed Fins Cool Cylinders

The engine is of ultra-modern design, with overhead valves, overhead camshaft, and a seven-bearing pressure lubricated crankshaft. The cylinders are equipped with vertical, air-jacketed fins, the air being supplied by a blower on the front end of the crankshaft and passing through a duct that incloses the overhead valve mechanism.

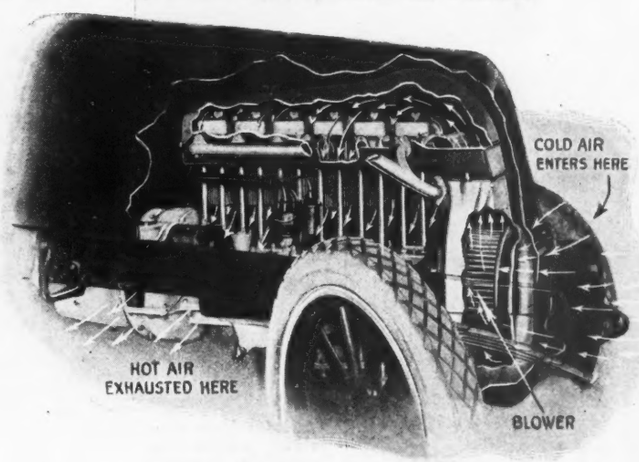
And now, the manufacturers of one of America's most popular medium priced cars that always in the past has been water cooled, have gone one step beyond the makers of air-cooled cars, using copper cooling fins in place of cast iron fins integral with the cylinder walls. Since copper has twice the conductivity of cast iron, heat will flow through the copper fins many times as readily as it will through cast iron fins. In the new car the copper fins are welded to the cast iron cylinders—and this in itself is a real engineering triumph. Welding of this sort is essential for successful use of copper fins; for if the fins were merely forced into slots in the exterior of the cylinder walls the cooling effect would be largely lost, because heat flows through a joint about as reluctantly as an electric current jumps a gap.

Still another clever feature of the new engine is the "looping" of each fin so that a hollow "boat shaped" passage runs down through its center. A suction fan at the front of the engine sucks up the air through these fins into a duct that covers the cylinder heads. Since the fins are hollow and the air passes through them, no air jackets are required.

Fundamentally every automobile engine in the world is air cooled! In the water cooled car the water is merely the agent that takes the heat away from the cylinders in a hurry and dissipates it into the air by way of the radiator, which has a surface many times the area of the cylinder walls. It is the air flowing through the radiator that finally receives the heat that seeps through the cylinder walls.

In the newest air cooled car, the copper cooling fins draw the heat from the cylinder walls just as quickly as does water, and the rush of air through the hollow fins is sufficient to carry the heat away as fast as it is withdrawn from the cylinder walls.

That, in a nutshell, is the reason why the improved air cooled engine is the equal of the water cooled design in every respect, and why we may safely predict that air cooled cars will be the popular cars of the future, largely replacing the water cooled car



Latest model of the one air cooled car that has enjoyed success for years. Observe that the direction of cold air flow is the reverse of that in the newest air cooling system shown at the top of the page—that is, the cold air is sucked in at the front

This

Bright Lights Cost New York $70,000,000 a Year

© Warnecke Photos

IT COSTS New York more than $70,000,000 yearly to present this spectacular display. More than 2,000,000 tons of coal, costing $16,000,000, are required to produce the 1½ billion kilowatt hours of electricity consumed by the city in a year. The street lighting alone involves an expenditure on the part of the municipality of over $3,000,000, for 12,000,000 filament lamps are required to supply the necessary illumination for the crowded thoroughfares of the great metropolis

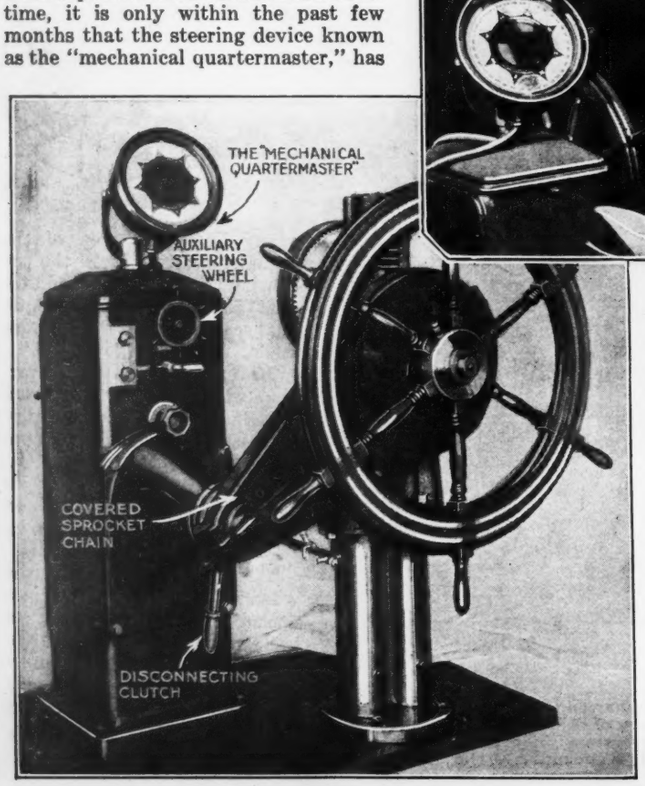
Automatic Quartermaster Steers Ship

ADD to the long list of modern mechanical marvels the self-steering ship, guided by an automatic quartermaster.

This remarkable maritime development is made possible by the invention of the steering gyroscope, an instrument based on the inventions of Elmer A. Sperry, of New York City, and is an adaptation of the gyro-compass now extensively employed. It steers a vessel along any predetermined course without the aid of human hands.

A ship equipped with a master gyro-compass may have, in addition, bearing, recording, and steering repeating compasses that operate under the influence of the master. While the first two of these repeaters have been used for some time, it is only within the past few months that the steering device known as the "mechanical quartermaster," has been made practical. While the master compass keeps an accurate account of all angles in the ship's course in relation to the earth's meridian, the steering repeater utilizes this account by adjusting the steering mechanism so that the progress of the ship will conform to these angles. Thus, should a variation of five degrees be required, the ship will be turned until the master compass records a five-degree angle with the meridian.

The manufacturers claim that the "mechanical quartermaster" has steered ships over 4000 miles, with less deviation than is obtainable with the usual steering gear.



Above: The "mechanical quartermaster" or steering gyroscope, steers the ship automatically along a predetermined course

At left: How the new automatic steering instrument, controlled by a master gyro-compass, is connected with the pilot wheel that it controls

Ringing of Alarm Clock Switches Off Lights

TO SWITCH off the lights automatically in show windows of stores after closing time an ingenious alarm clock control has been invented by William Frisby, of Colchester, England.

The device, which can be fastened to any ordinary snap switch, consists of a hinge attached to the switch, two chains, a ring, and an ordinary alarm clock. When leaving the store at the closing hour, the manager sets the alarm and hooks the ring at the end of the chains over one end of the alarm winding key. When the alarm goes off, the key turns, thereby releasing the ring and causing the clock to fall a short distance.

The pull of the falling clock causes the hinge on the switch to strike the contact button and the electric current is thus turned off.

Raw Starch Is Digestible

IT WAS generally believed that raw starch was harmful, and that all starchy foods must be thoroughly cooked to be digested properly by human beings. This has been disproved in experiments conducted by the Department of Agriculture.

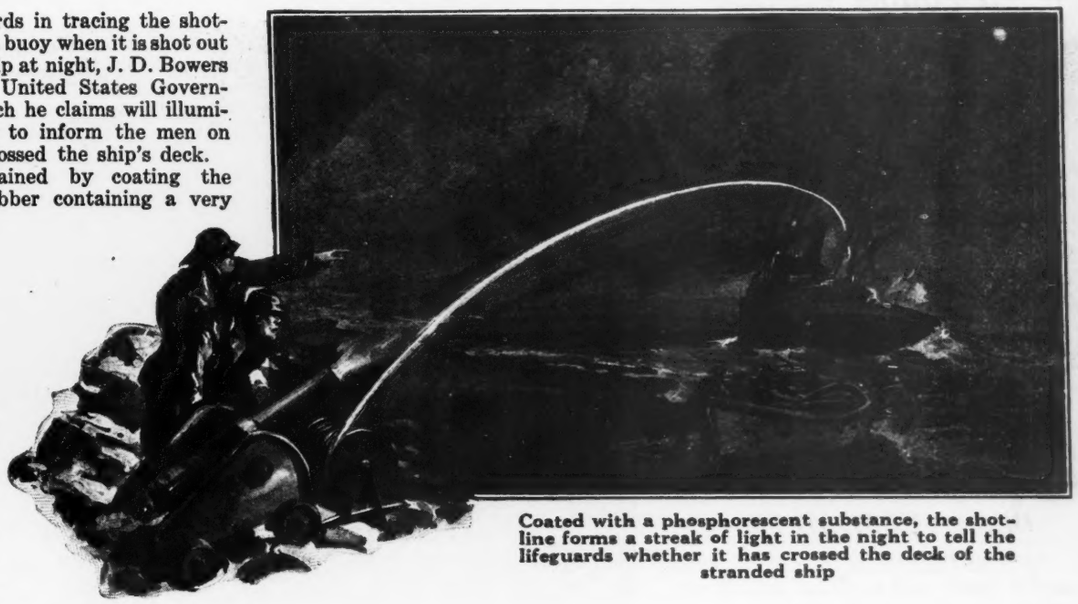
Cornstarch, wheat starch, and rice starch were all completely digested when eaten in a frozen pudding in which they constituted 20 per cent of the entire dish.

Illuminated Lifeline to Aid in Shipwreck Rescues

TO AID coastguards in tracing the shotline of a breeches buoy when it is shot out to a stranded ship at night, J. D. Bowers has submitted to the United States Government an invention which he claims will illuminate a line sufficiently to inform the men on shore whether it has crossed the ship's deck.

Illumination is obtained by coating the line with dissolved rubber containing a very small amount of radium plus a chemical or mineral that will shine under the influence of radium rays. Other coating materials that are phosphorescent after they have been exposed to bright sunlight or to artificial light, have been suggested.

The invention is expected to solve one of the chief difficulties in shooting the lines accurately.



Coated with a phosphorescent substance, the shotline forms a streak of light in the night to tell the lifeguards whether it has crossed the deck of the stranded ship

Midget Cyclecar Coupé Marks Radical Step in Auto Design

ALL conventional rules of automobile construction have been thrown overboard in a startling new development of the small cyclecar designed by two British motor enthusiasts—a streamlined midget coupé that stands no higher than a man's shoulder, runs on top gear at a walking pace, and travels at a speed of 55 miles an hour.

Engine Mounted on Vertical Shaft

The most tradition-defying feature of this air cooled four-seater is its power plant. The engine is mounted within the streamlined tail—and on a vertical shaft. It is of the radial type, its five cylinders placed in a radial position around the shaft. The cylinder casings, resembling those of an ordinary motorcycle engine, are equipped with vanes that catch the cold air as it is projected downward by fan blades attached to the rim of the horizontally rotating flywheel surmounting the drive-shaft.

From the drive-shaft, the power is transmitted through a single disk clutch direct to separate wheel shafts. Three speeds are provided and are controlled in the usual way from the driver's seat. Since the drive-shaft is vertical, the usual means of lubrication cannot be employed and therefore a pump system was installed. Oil is forced up through a series of spiral grooves within the shaft, and wells over when it reaches the top. Flowing down along the shaft, this oil lubricates all the bearings on its way to the sump well. Since the engine is air cooled, no water need be carried. The gasoline is kept in a tank situated under the hood.

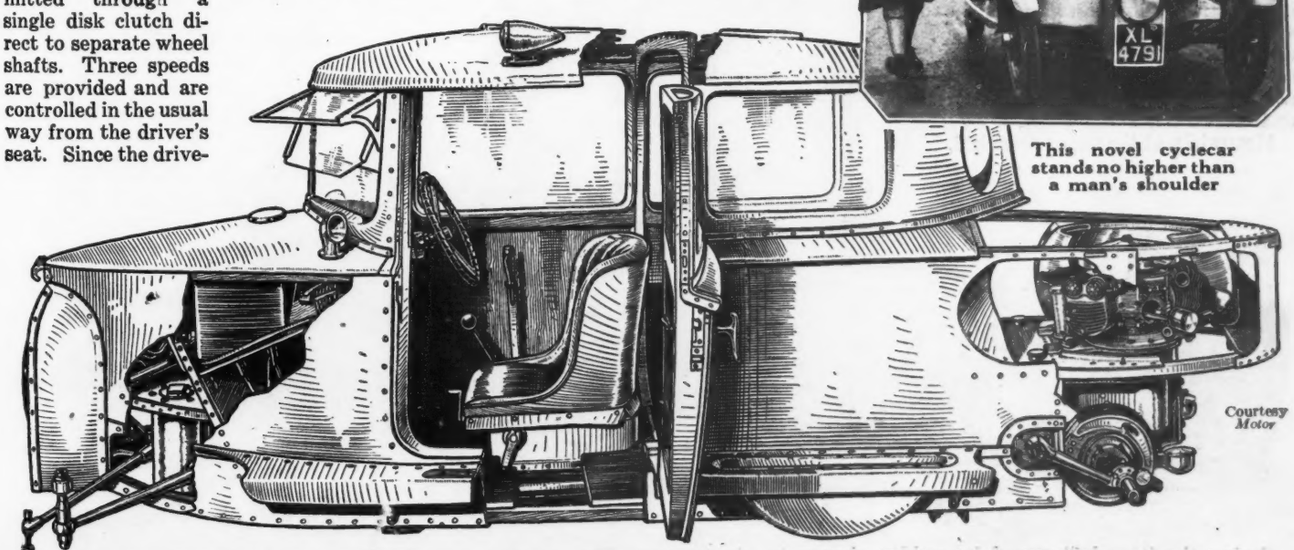
In place of the usual single rear axle, each rear wheel is mounted by roller bearings on a short stub axle. The front wheels are also separately mounted and when turned, they carry the mudguards with them; for the suspension that supports the wheels serves as the mounting for the guards.

The body and chassis form a single unit. A six-inch aluminum section, to which the runningboard is integrally fastened, forms both the side of the body and the side supporting member.

Shocks are absorbed not by springs, but by an ingenious hydraulic method. When the wheel is projected upward, it moves a piston within a cylinder filled with oil. This oil is forced through a beveled orifice against the reaction of a small spring. This dampens every shock, resulting in exceptional riding qualities over the roughest roads.

The unusual suspension is such that the load comes midway between the wheels and the center of gravity is very low. This even distribution provides exceptionally comfortable riding.

This novel cyclecar stands no higher than a man's shoulder



Courtesy *Motor*

This cutaway view shows vertical mounting of the engine at the rear and other extraordinary features of the new cyclecar

How Engineers Build a Tunnel Miracle

Boring the World's Largest

ARMED with keen, knifelike edges, four gigantic steel cylinders bore like moles beneath the Hudson River, cutting their way, inch by inch, through sand and solid rock and building steel-lined burrows behind them. Two of them strike out from the New York shore, westward bound; two from the New Jersey side, eastward bound.

Slowly, a few feet a day, the westward bound borers and the eastward bound borers creep toward each other. When, after three years of stupendous labor and skill, they join at last, far beneath the river bed, they will have completed one of the greatest engineering feats in history —the construction of two immense underriver highways nearly two miles long, through which 50,000 vehicles will pass each day.

Digging a $30,000,000 Burrow

In those three years they will have removed nearly half a million tons of rock, gravel and silt. In the burrows behind them will have been placed 115,000 tons of cast iron and 130,000 feet of concrete lining. At least $30,000,000 will have been spent (preparations alone have cost not less than $2,000,000), and hundreds of hardy caisson workers—"sandhogs"—will have risked death and disease.

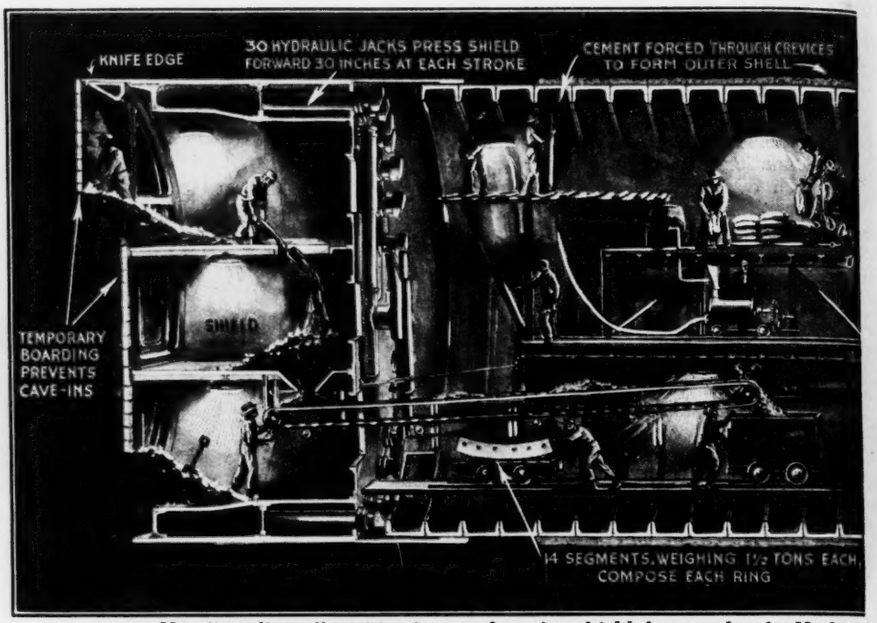
Imagine a tin can 30 feet in diameter and 18 feet long, with both ends knocked out and a partition or bulkhead dividing it into two chambers, the forward chamber twice as long as the rear one. Picture this can as made of steel weighing 400 tons, armed with a cutting edge in front—and you have an idea of one of the boring shields for the new Hudson traffic tubes.

Where Sandhogs Work under Pressure

In the forward compartment the sandhogs, working with pick and shovel, chop away the earth and rock ahead of them and pass the loosened material on conveyors back to the rear chamber. These men labor under terrific air pressure—60 pounds to the square inch sometimes—to prevent water, sand and muck from engulfing them.

And as they bore ahead, gradually chopping a passage under the river, hydraulic jacks fitted into the bulkhead, thrusting with irresistible power, force the 400-ton cylinder forward. Again and again this titanic operation is repeated, advancing the great shield about 2½ feet a day through rock, or 15 feet a day through silt.

Meanwhile, at the tail of the shield,


KNIFE EDGE
30 HYDRAULIC JACKS PRESS SHIELD FORWARD 30 INCHES AT EACH STROKE
CEMENT FORCED THROUGH CREVICES TO FORM OUTER SHELL
SHIELD
TEMPORARY BOARDING PREVENTS CAVE-INS
14 SEGMENTS, WEIGHING 1½ TONS EACH, COMPOSE EACH RING

How "sandhogs," working in a steel cutting shield, bore under the Hudson

a huge arm lifts 3000-pound segments of a cast iron ring and fits them in place within the rim of the shield to form a new section of the tunnel tube. Each ring is made up of 14 segments six feet long, with a key segment at the crown of the arch, all bolted together with 160 10-pound bolts. All joints of the segments are calked and any voids between the exterior of the ring and the surrounding silt, rock, or sand are filled in with cement forced from the interior of the tunnel under high air pressure.

Each cast iron circlet that makes up one 30-inch length of the tube weighs 22 tons, and the whole outer shell of the two underriver highways will weigh 115,000 tons. And this is only part of the total; for at 800-foot intervals there will be huge concrete caissons, and the tube itself will be lined with tile, reinforced with concrete and paved with granite. Even at that, it may be necessary to tie the whole thing down with additional sinkers!

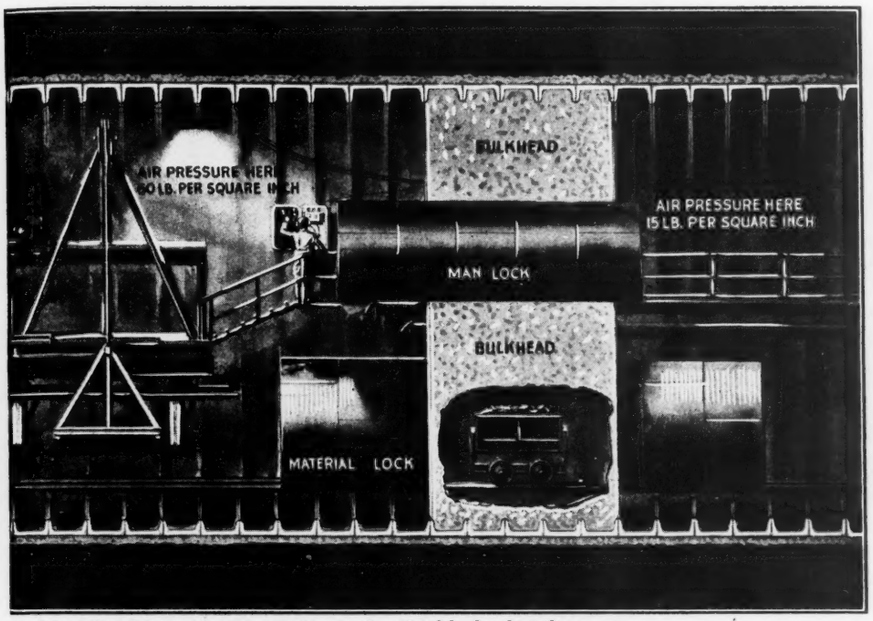
Workmen Brave Dread Disease

The sandhogs work in pairs—a miner and his helper. They must be unusually hardy men, constitutionally able to withstand terrifically high air pressures. Changing from one air pressure to another often causes what underground workers call "the bends," otherwise known as caisson disease, caused by the presence in the blood of too much nitrogen. The change in pressure becomes too rapid to allow the human machinery to keep itself in proper adjustment.

To avoid injury and possible death to the workers in this way, the change in pressure is made gradually by means of air locks fitted into a bulkhead in the tube some distance behind the working shield. These locks are chambers that may be put in communication either with the high pressure interior of the caisson tube or with the outside air, at will. They are equipped with valves and other devices that make it possible to increase or decrease the air pressure in them very gradually. Entering the working shield, the workers pass first

Curing the "bends," caused by sudden change in air pressure. The patient is placed in a pressure suit and subjected to the same air pressure that caused the disease. This pressure is then gradually reduced

Underwater Motor Highway



and build a huge cast iron tube as the shield slowly advances

into the air lock. The doors of the lock are then tightly closed, and the pressure within is slowly increased until it becomes equal to that under which the work is being done in the tube. When the workmen leave the tube, the operation is reversed.

When a workman is attacked by the "bends," he becomes as helpless as if he were dead drunk. For a cure, he is placed in a tank or a pressure suit and subjected to the same atmospheric pressure that caused the disease. Gradually the pressure is reduced to normal and the "bends"—if the patient lives—vanish.

Preparations for work on the Hudson traffic tunnels began last fall. They included costly experiments to discover adequate means of ventilating the tunnels when completed—a problem unusually difficult because of the extreme length of the tunnel and the necessity of drawing off exhaust gases from the thousands of motor vehicles that will pass through.

The United States Bureau of Mines, working with Dr. Yandell Henderson, consulting physiologist at Yale University, decided that to make the tunnels safe from poisonous carbon dioxid gases, the air should contain not more than four parts of carbon dioxid to 10,000 of air. The fresh air, it was decided, will be forced by blowers, housed in buildings above four ventilating shafts for each of the tunnels, into ducts beneath the tunnel roadways, pass through flues to continuous expansion chambers out across the roadway and slowly ascend to the ceilings. The air will remain in the tunnel on an average of 90 seconds and carry the exhaust gases away.

Workmen Risk Death to Complete Feat

What Traffic Will Be in 1940

The first of the great boring shields started on its way last November from a concrete caisson shaft at the foot of Canal Street, New York. According to present plans—and the work thus far has progressed without a hitch—the two tubes, 1¾ miles long from portal to portal, will be completed by Jan. 1, 1926. As soon as the tunnels are ready for service, it is estimated that 17,000 vehicles will pass through them each day. After six years of operation, this number will be increased to 24,000 a day; and by 1940 it is believed that the tubes will accommodate 50,000 vehicles every 24 hours.

When completed, the great vehicle tunnels are expected to help solve the living problem for millions. Motor trucks passing through the tubes will carry tons of food products from New Jersey farms and warehouses to the Manhattan consumer.

The tunnels will be a triumph of the motor truck for short hauls. They will relieve thousands of week-day delivery drivers and more thousands of Sunday tourists, from the tedious journey across the Hudson by ferry.

Press a Button, and Automatic Phonograph Plays Your Tune

AN AUTOMATIC magazine type phonograph, recently invented by Oberlin Smith, of Bridgeton, N. J., is controlled from a switchboard which can be moved to any part of the house. By pressing any two buttons on the board, the operator can play any one of 50 records, or he can repeat any record again and again without moving from his chair. One of the buttons selects a record, while the second starts the machine.

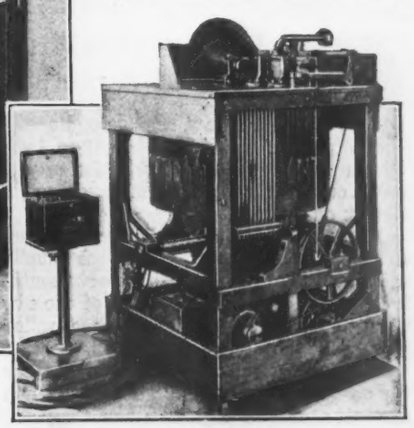
In the operation of the machine there are four stages that follow each other automatically. When the two buttons are pressed, the current from the house circuit is turned on to provide the power, and a cylindrical drum, containing vertical slits in which the various records rest, turns around until stopped by a magnet controlled by the selective switchboard circuit. The disk record desired is then in position to be raised vertically from the drum by a rectangular frame.

All You Do Is Listen

As the disk emerges from the top, it is grasped by two jaws which swing it into a horizontal position upon the phonograph turntable. The jaws are then released and the turntable starts rotating. The needle is slowly lowered to the edge of the record, following the grooves to the end of the record. The machine is then stopped automatically and the operation is reversed, thus returning the record to its original place in the drum.

The location of the needle for starting and stopping any particular record, is governed by a wooden pin, which is inserted with the record in a hole in the turret. Thus for a 12-inch record having a four-inch run, a rod of definite length is inserted. When records are changed, new pegs are used. These pegs can be made of old pencils or doweling material.

The selection of a record by pressing one button, and the starting of the operation by pressure on a second button, locks the switchboard until the record is finished. Then all buttons spring up, indicating all clear for another record.



The mechanism of this magazine type phonograph, with switchboard, is shown at the right

Quarter Million Stamps Form Mosaic

IT TOOK 250,000 cancelled postage stamps and a generation of labor to complete a novel mosaic, entitled "Philatelia," by W. Reichelt, an artist of Teplitz, Czecho-Slovakia.

The picture, portraying a woman gathering poppies, contains a collection of postage stamps of all the nations of the world — a wide variety being necessary to obtain the desired color combinations. Many stamps more than 100 years old were used. American stamps formed the poppies while British aviation stamps made up the blue sky background.

The mosaic has been insured against burglary for $100,000, and was held in the New York Customs House for several months after its arrival in this country because no one could be found who could place a valuation on it with any degree of accuracy, it being a unique work of art.

Of 250,000 stamps coloring this mosaic, American stamps form the poppies and British aviation stamps the sky

Sponge Spreads Mucilage from This Container

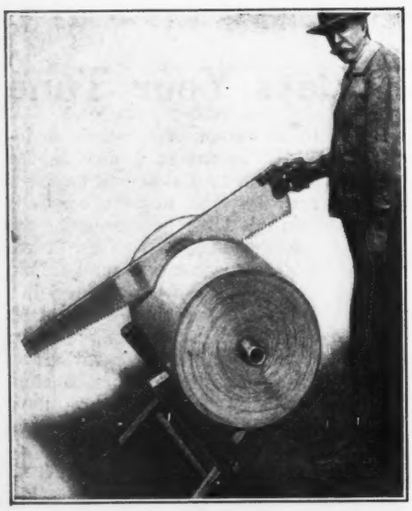
THE mucilage bottle has long been an annoyance because of the difficulty of keeping the mucilage in proper condition while still providing a ready means of using it neatly.

A New York concern has recently marketed a container the top of which is provided with a sponge. Inverting the bottle causes the mucilage to flow into the sponge, which serves as a spreader.

Hawaiian Plantation to Combat Leprosy

IN THE battle of science to stamp out the plague of leprosy, plans are now under way to establish in the Hawaiian Islands a plantation of taraktogenos trees. The oil obtained from the seed of this tree—chaulmugra oil—has been responsible for hundreds of cures of the dread Oriental disease, thanks to discoveries made by two London doctors nearly 20 years ago, after much research.

It is largely due to the daring of Joseph Rock, one of the adventurous agricultural explorers of the United States Government, that enough of the seed has been obtained to form the nucleus for an extensive grove of these trees, according to Henry C. Fuller in his new book, "The Story of Drugs" (Century Co.).



World's Largest Handsaw Cuts Rolls of Paper

A 48-inch handsaw, said to be the largest in the world, has been built by an Eastern manufacturer for special use in cutting through rolls of paper wound tightly on brass tubes.

Many of these paper rolls are 24 inches in diameter, while the brass tubes usually are two inches thick with one-sixteenth-inch walls. The mighty sweep of the saw blade goes through the machine rolled paper and the brass tube as well.

The blade of this saw is about twice the size of the ordinary handsaw blade, and the tool stands as high as a small boy.

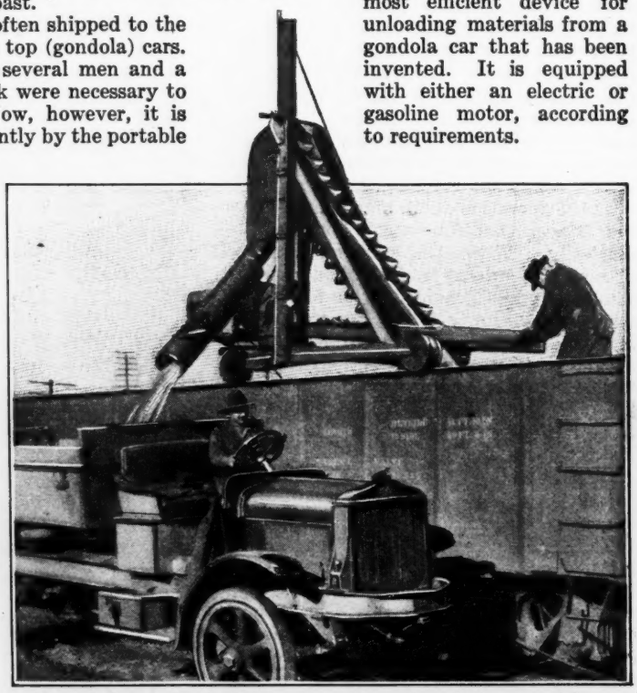
Car Sides Are Track for Unloader

THE problem of quickly unloading railroad cars filled with loose building and similar materials has been solved by a recently invented portable car unloader, that is now put into practical use in many cities on the Pacific Coast.

Loose materials are often shipped to the railroad sidings in open top (gondola) cars. Formerly the labor of several men and a slip scraper or a derrick were necessary to unload these cars. Now, however, it is done quickly and efficiently by the portable unloader, which is designed so that it can be assembled on the car and operated by two men. It is equipped with its own power unit and is capable of loading a five-ton truck in five minutes.

The device consists of a bucket conveyor supported by a steel framework resting on a three-wheeled truck using sides of the car as a track. The bucket conveyors may be raised to the top of the car and lowered as they eat into its contents. Raising the material, they drop it into a pipe chute, which conveys it into the truck that is waiting below.

The entire apparatus moves from car to car with ease, on rails that bridge the gap between cars. Only one man is needed to operate it. Its designers claim it is the most efficient device for unloading materials from a gondola car that has been invented. It is equipped with either an electric or gasoline motor, according to requirements.



Mounted on wheels that run on the sides of the car, this bucket conveyor unloads material as shown above

Rented Goats Clear Missouri Farm Land

By ones and twos, the kids are staked to wooden pup tents while their mothers are out foraging

This Angora buck eats almost anything

Like an army camp is this Angora goat stock farm in Missouri, where land clearing animals are raised

"FOR Rent: Four thousand Angora goats for the season at 50 cents a goat. Guaranteed to clear farm lands of undergrowth and rubbish."

That sounds like one more version of the ancient wheeze about the goat and the tin can. But it's not a joke at all for Ely Ashcraft, a farmer of Stone County, Mo.; it's a science developed into a good paying proposition. In fact, Ely's financial success in raising Angoras in pup tents, then leasing them out to nibble uncleared farm land, has induced fellow members of the American Angora Goat Breeders' Association to follow his example.

Goats Yield Threefold Income

And the farmers who rent the goats are profiting, too. They are saving manual labor that would cost them many times the rental price of the goats.

The goat breeders profit three ways: First, the rent money; second, free meals for the Angoras; and third, a substantial income from the mohair yielded by the rubbish eaters.

From two to five goats are usually assigned to clear an acre—depending on the density of the underbrush. When the brush is tall, the tops are cut off, and the goats nibble the leaves, impoverishing the plants and causing them to die.

Faring forth from their pup tent encampments, these shaggy armies are now advancing on Texas, Missouri, Arkansas, Louisiana, Oregon, Washington, Arizona, and New Mexico, reclaiming valuable farm lands. In the Willamette Valley in Oregon large troops of the animals are being used successfully on reclamation projects. In fact, the prolific fruit orchards in the Pacific northwest are, in a measure, testimonials to the success of this form of animal husbandry.

For rearing the Angora kids, the novel shelters pictured at the top of this page originated in Louisiana, where goats are being used extensively to clear cut-over lands. One by one or two by two—it all depends on size—the baby goats find shelter beneath small wooden tents, patterned after army tents, while their mothers are out foraging. At each tent the kids, wearing halters, are leashed to stakes in the ground.

Where They Come From

Twice a year the goats are robbed of their fleece by mechanical shears.

The Angora goat had its origin in Asia Minor, in regions from 1000 to 4000 feet above the level of the sea. Mild climate, adequate drainage, wholesome drinking water, and space for comfortable bed grounds are the essentials for goat ranges. Winter feed in more severe climates and plenty of underbrush are needed. Goat shelters on the ranges are usually simple in construction, consisting of low sheds with metal roofs boarded at one or two sides.

The Angora breed yields offspring once a year. October is the best breeding time.

On the march—a herd of Angora does nibbling undergrowth from cut-over lands in Missouri

Oblong Lens Detects Counterfeits

Placed on the inclined glass of this reflector box, a suspected bill or check is highly magnified in one dimension by a curved lens shown at right

TO MINIMIZE the possibility of cashing altered checks and counterfeit bills at banks, a New York concern has recently placed on the market a magnifier that enables the teller to determine immediately any deviation from the design of a genuine bill or from a genuine signature on a check presented at the bank.

The magnifier consists of a reflecting box in which is mounted an electric lamp. Rays passing up through an inclined glass at the top of the box, upon which the bill is placed, pass through a curved lens which magnifies the bill in one dimension only. The resulting distorted image permits ready detection of differences in the location of silk threads in a bill. Bleached counterfeits show up very plainly.

Any alterations of a check examined in this way are highly magnified, while forged signatures can be detected by superimposing two checks, one bearing a signature which is known to be authentic.

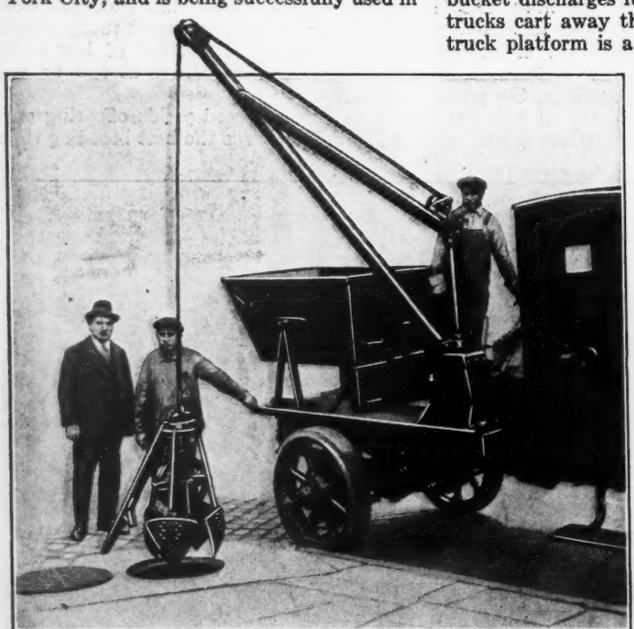
The magnifier may be attached to any electric light socket.

Motorized Grab Bucket Cleans Sewers

A MIDGET grab bucket of the orange peel type, which does away with the odious task of cleaning sewers or manholes by hand and so cuts the cost of the labor, has been invented by P. J. Healy, of New York City, and is being successfully used in cleaning out the basins in Perth Amboy, N. J.

The machine consists of a motor truck upon which is mounted an especially designed dumping body into which the grab bucket discharges its load and from which trucks cart away the material. Upon the truck platform is a mast and boom, from the end of which is suspended the bucket. The mast is so mounted upon bearings that it can swing the bucket into any position, thus making it unnecessary for a workman to go down into the sewer.

The grab bucket, operated by the truck engine, is suspended from three cables, one for lowering and the others for opening and closing the leaves of the bucket. A series of tests have shown that catch basins can be cleaned in from 20 to 30 minutes by the grab bucket, where hand labor would require hours. A further advantage is the rapidity with which the device can be moved.



Courtesy the *Commercial Vehicle*

Suspended from a boom attached to a motor truck, the grab bucket is driven by the truck engine

Artificial Sunlight for Small Aquariums

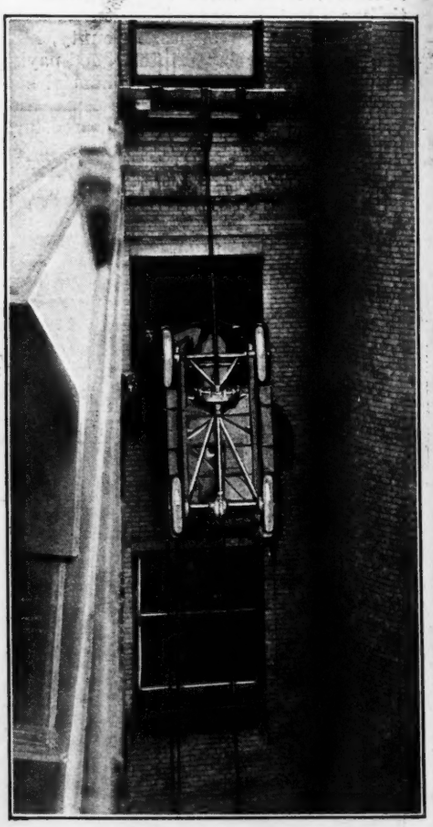
TO SUPPLY the small home aquarium with artificial sunlight, a Chicago inventor has designed a fish bowl with electric light attachment that floods the fish with color rays of which they are usually deprived when taken from their natural surroundings.

Car Jumps Back on Track

IN A remarkable accident on the Northeastern Railway, near Stannington, England, recently, a derailed car, after breaking nearly 1000 of the fish-plates that hold the rails to the ties, jumped back on the rails while the train was speeding at 60 miles an hour.

The car was part of a fast freight. The astounding feature of the accident was that the train continued at its high speed.

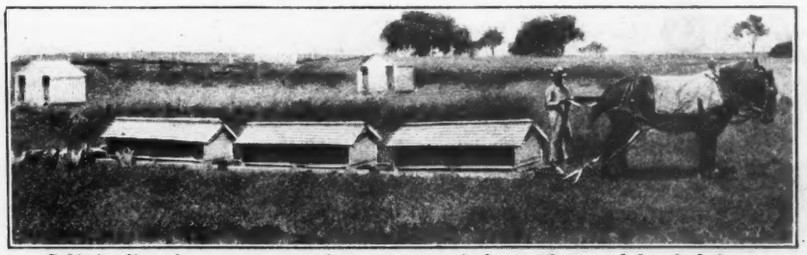
Auto Hoisted to Window on Seventeenth Floor



IN ORDER that a coupé automobile, which was a prize in a recent Chamber of Commerce campaign in Omaha, Neb., might be exhibited in the rooms of the organization, it was necessary to hoist it 17 stories, remove a window to admit the car, since no elevators were large enough to carry it.

Chickens Eat "Cafeteria Style" on Uncle Sam's Poultry Farm

THE popularity of the "help yourself" plan of dining is not limited to humans. On the 60-acre chicken farm maintained by the United States Department of Agriculture, at Beltsville, Md., the cafeteria style of eating is practised in satisfying the appetites of approximately 4000 fowls. Here Uncle Sam conducts feeding and breeding tests that supply valuable information to poultry raisers throughout the United States.



Self feeding hoppers on runners are coupled together and hauled from place to place on the government farm. The chickens help themselves

These chicken cafeterias, or self-feed hoppers, are built on runners—an arrangement that permits easy removal from one place to another on the farm. A group of the cafeterias may be linked together with chains and drawn by horses to any portion of the poultry experiment station.

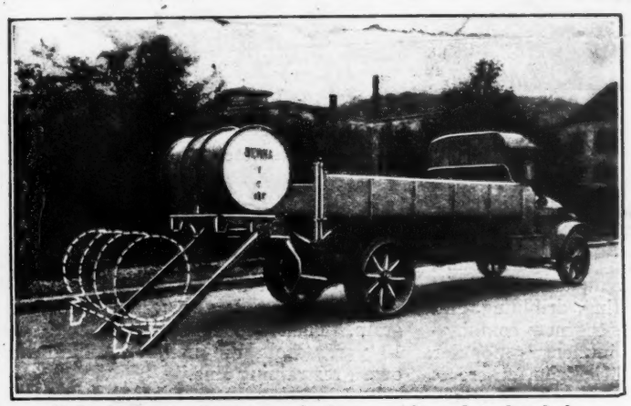
The self-feed hopper is an open trough arrangement in which the various rations are deposited. The chickens help themselves to whatever variety of food their appetites may dictate. This method of feeding poultry not only saves labor on a large ranch, but also prevents waste of feed.

Hand Crank Runs Simple Truck Loader

IN ORDER to facilitate the loading of trucks, a Swiss concern has perfected a loading winch that raises an elevating platform along two skids up to the level of the truck bottom.

When lowered, the platform is seven inches above the ground. This is sufficiently low for a barrel or crate to be rolled or tipped upon it. A winch, operated by hand with a crank, raises the loaded platform along the skids until it is level with the truck floor.

When not in use, the attachment is removed by releasing two hooks from eyes set in the rear of the truck body, and it can be placed for use on another truck or folded and stored.



Rolled on an elevating platform, a barrel is hauled up skids to the truck floor by turning a hand crank

Motor Driven Bracket Drill for Small Workshop

A SIMPLE, inexpensive post bracket drill, suitable for operation within a radius of 3½ feet, has been perfected recently by a concern in Cleveland, Ohio, to provide a useful addition to the small workshop of the mechanic or garage owner.

Operated by a small electric motor, the machine is especially adapted to the manufacture of stoves, as well as electrical and switchboard work. The drive is through tight and loose pulley countershaft and bevel gears to an upright shaft near the post. Belts transmit this power through pulleys. Two arms are provided, giving great flexibility of adjustment.

To operate, the work is placed conveniently within the maximum radius of the machine, the arms are loosened and the spindle is then centered over the work. When the proper position has been secured, the arms are locked in place and the spindle is caused to rotate by throwing the belt from the loose to the tight pulley on the power shaft.

Auto Speeders Checked Automatically

A SPEED control mechanism for automobiles has been invented by Col. Charles Gore, of Los Angeles, Calif., to automatically check a car from exceeding a specified speed limit, notifying the driver when the limit is reached, and registering the attempts made by the chauffeur to exceed that limit.

Like a speedometer, the attachment is actuated by the turning of the car wheels. The register does not begin to function until the maximum speed as previously set is approached. Then a red lamp flashes and a buzzer sounds.

After these two signals, any increase in speed shuts off the motor, which cannot be started again until the driver presses a button on the side of the case. This pressure is transmitted to a recorder which makes a permanent mark to indicate an attempt at speed violation.

While the device is especially applicable to trucks whose owners desire to keep their chauffeurs driving within the safe speed, it can readily be adapted to all kinds of motor vehicles.

On this speed arrester, red lights flash and a buzzer sounds when the driver exceeds the speed limit

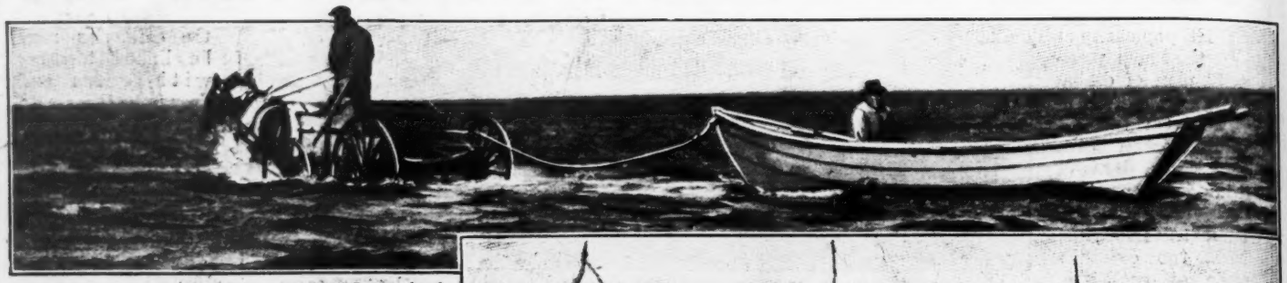
Starving to Death

WHAT happens when persons starve to death? Startling new information on the subject has been supplied by Dr. George B. Hassin, a nerve specialist of Chicago, who recently returned to the United States from Russia with the brain of a man who died of starvation.

Investigations by scientists indicate that the starving body first feeds on surplus fat and waste matter. Proportional losses at death are:

Fat, 97 per cent; muscle, 30 per cent; liver, 56 per cent; spleen, 63 per cent; blood, 17 per cent; nerve centers, 1 per cent.

Fisherman Goes to Sea with a Horse and Wagon



© International

UTILIZING the tides to trap fish, Warren Burgess of New Brewster, in the Cape Cod section of Massachusetts, has established what he calls a "fish farm." He "harvests" his catches with a horse and wagon.

Nearly two miles out to sea on the flats, Burgess has erected weir nets or fish traps, the netting being supported by sturdy saplings. Into these weirs the fish are lured at high tide, when the sea is above the tops of the nets, and when the sea recedes with the tide, they are left trapped in the nets. At low tide the water is so shallow that Burgess can drive his horse and wagon, with a dory attached, out to the nets and bring in the fish.

Nearly 5000 poles are used to hold up several traps Burgess has installed and he makes immense catches of herring, mackerel, and other fish.

How horse and wagon harvest fish trapped in nets at low tide

Newest Sport Combines Football, Basketball, and Soccer

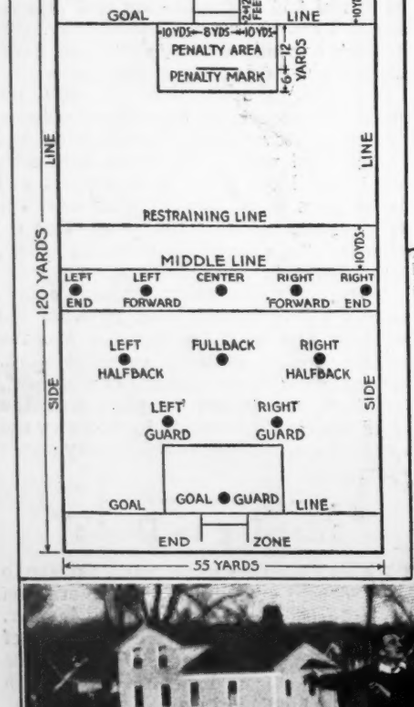
SPEEDBALL—an exciting game for everybody, combining skill, speed, and teamwork—is America's latest sport. Borrowing the forward pass, punt, and drop kick of football, the passing of basketball and the kicking, dribbling, and fast charging of soccer, the new combination game has become immensely popular at the University of Michigan, where it was invented by Elmer D. Mitchell.

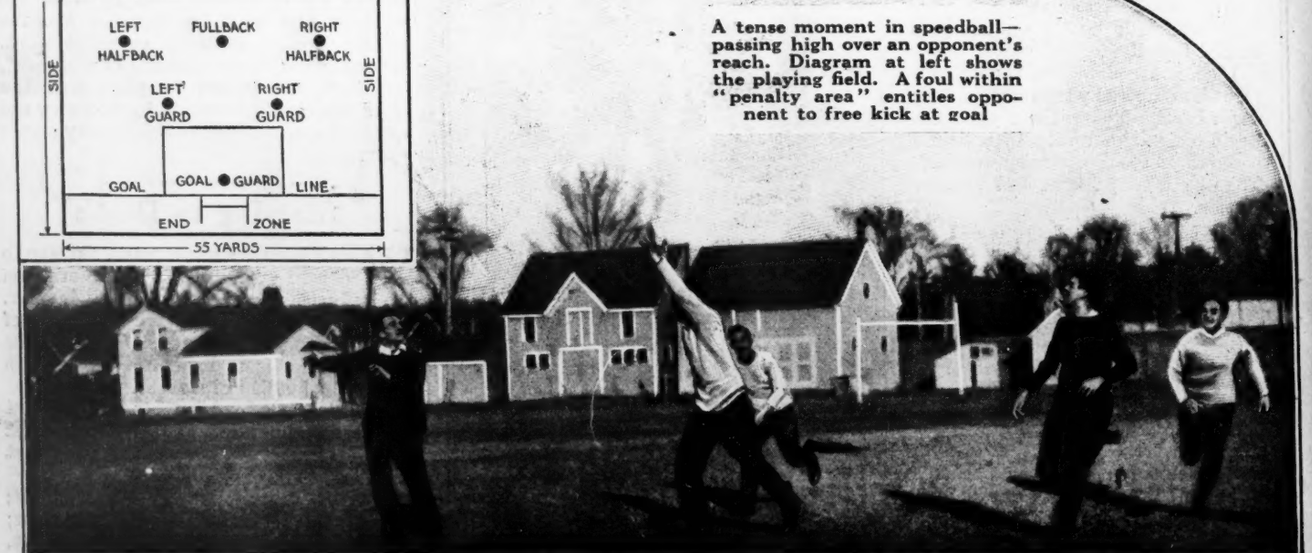
Speedball is played on a regulation football field, with a regulation soccer ball. There are 11 men on a side. The object of the game is to kick the ball under the crossbar of the opponents' goal for three points; to drop kick over the crossbar for one point, or to pass over the goal line for two points.

The positions of the players on the offensive team at the kick-off from midfield are shown in the accompanying diagram. Their opponents must keep at least 10 yards from the ball, or behind their own "restraining line."

The kicking team charges behind the ball, just as in football. As long as the ball rolls along the ground, soccer restrictions hold and no man on either team may touch it with hands or forearms. But a fly ball may be caught, passed to a team mate, punted, or dribbled in the air—that is, thrown up and caught again.

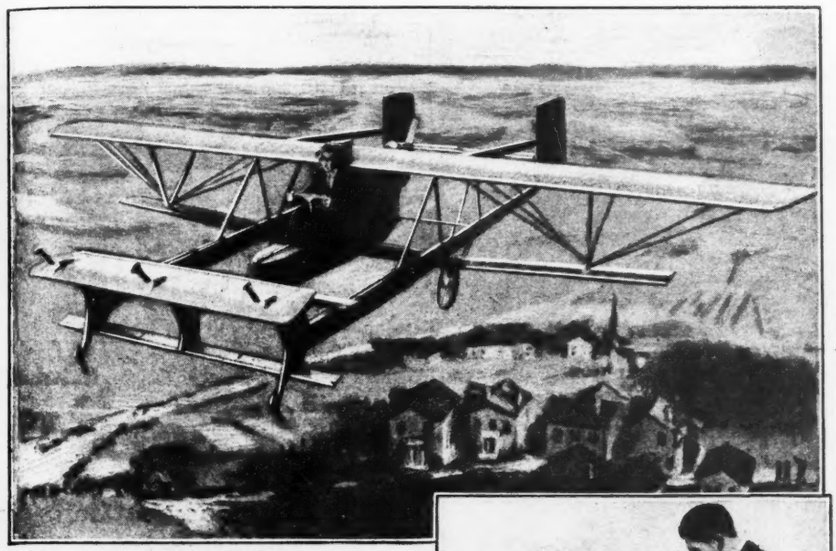
Opponents can block a man with the ball, but may not tackle him.



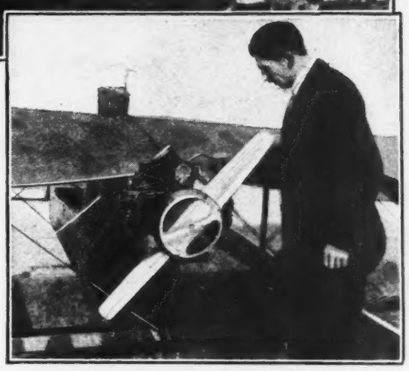


A tense moment in speedball—passing high over an opponent's reach. Diagram at left shows the playing field. A foul within "penalty area" entitles opponent to free kick at goal

Tiny Motor Starts Novel Glider



The new "pusher" sailplane and its small auxiliary propeller motor



WHILE French airmen have been smashing world's gliding records, remaining in the air without engine power for more than eight hours at a stretch, a German inventor has been busy perfecting a light sailplane of unusual design, equipped with a two-cylinder, four-horsepower motor. The addition of this midget power plant is merely to give starting speed and assure safe landing.

This important development in soaring flight fulfils the prediction of Augustus Post, secretary of the Aero Club of America, in the November, 1922, issue of POPULAR SCIENCE MONTHLY. He forecast the use of auxiliary motors in future sailplaning.

In the new German machine, the motor drives a propeller less than three feet long, but sufficiently powerful to start the plane on its upward flight. As prophesied in Mr. Post's article, it is no longer necessary for gliders to start from the top of a hill and for aviators to be content to coast into the valleys below. By taking advantage of air currents, the pilot is able to manipulate his sailplane in such a way that altitudes much higher than the starting point can be reached.

In appearance the new auxiliary glider resembles the earliest airplanes in that it possesses a set of small wings in front of the main spread. These bow wings are used when the driver desires to change elevation.

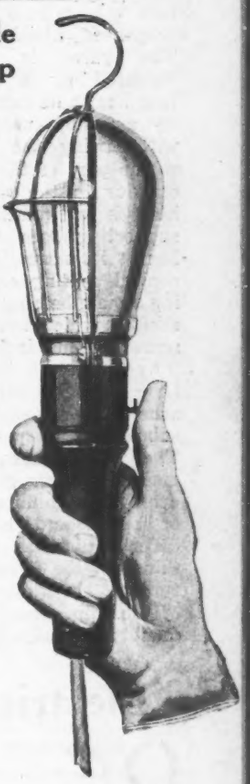
The plane is of "pusher monoplane" type—that is, the engine and propeller are in the rear, and push the plane through the air.

Does Your Sense of Touch Play You False?

DID you know that besides optical illusions, there are illusions of feeling? The proof is very simple. Take a small round pellet about the size of a pea. Cross the middle finger over the first finger in such a way that the tip of the middle finger is on the thumb side of the first finger. Now insert the pellet between the crossed fingers and roll it about the surface of the table. You will be astounded to find that you distinctly feel two objects about half an inch apart.

The explanation of the experiment rests in the fact that the pellet is touched by the opposite sides of the two fingers, and, consequently, two sensations of touch arise instead of one.

Switch in Handle of Trouble Lamp



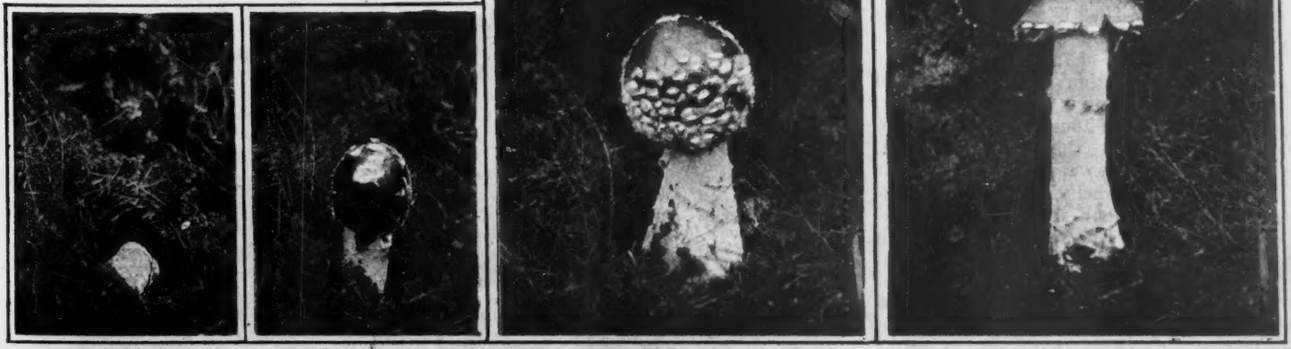
SQUEEZING the fingers between the guard wires on a trouble lamp to turn on the switch has caused so much annoyance in the past, that a manufacturer in Valparaiso, Ind., has decided to eliminate this difficulty by placing the switch in the handle where it is within easy reach of the thumb.

Constructed with the usual guard, reflector and hook for hanging, this lamp will prove convenient for garage mechanics and others who work around automobiles because of the ease with which the current can be turned on and off. It would also be found useful in the home.

Poisonous Mushroom Reaches Full Growth in Twelve Hours

ONE of the most amazing instances of rapid plant growth is found in the case of the fly fungus or *Amanita muscaria*, which reaches full maturity within 12 hours after its cap first pierces the surface of the ground. In general appearance this mushroom resembles the edible type, but it is extremely poisonous, for it has a large content of muscarine, a poisonous alkaloid. Eating one of these fungi by mistake will produce vomiting, general spasms in the abdomen, and finally death.

All fungi of this species grow on the ground, the fly fungus preferring woodland areas. Underneath the cap of this species is a series of plates or gills on which are produced the spores. It is this that distinguishes the poisonous types.



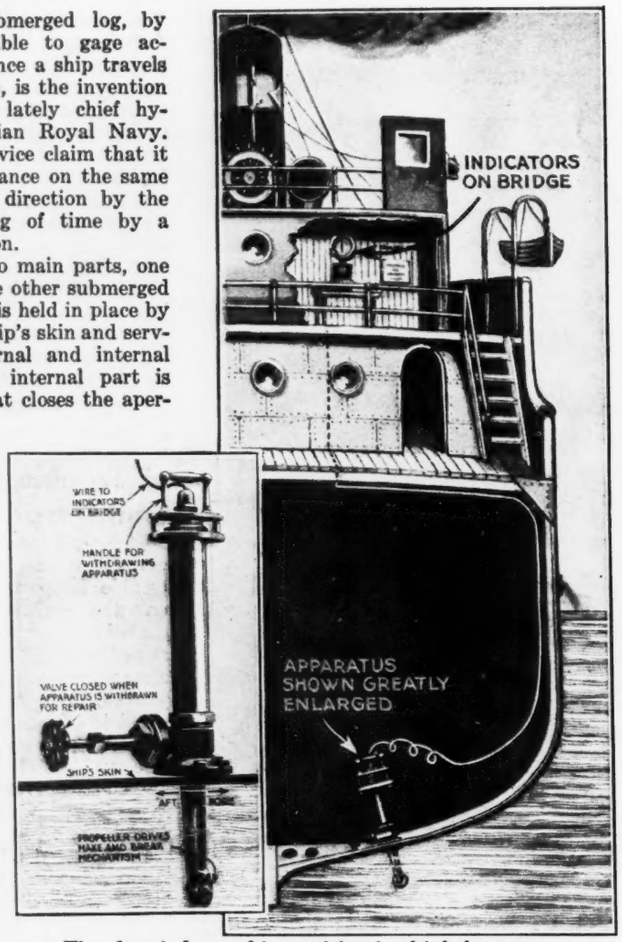
At 8 a.m. At 11 a.m. At 1 p.m. At 4 p.m.

Electric Log Tells Ship's Speed

A NEW electric submerged log, by which it is possible to gage accurately the distance a ship travels in a given length of time, is the invention of Captain Chernikeef, lately chief hydrographer of the Russian Royal Navy. Manufacturers of the device claim that it places the gaging of distance on the same plane as the gaging of direction by the compass and the gaging of time by a chronometer in navigation.

The log consists of two main parts, one inside the ship's skin, the other submerged outside. The apparatus is held in place by a flange, bolted to the ship's skin and serving to divide the external and internal part of the log. The internal part is simply a sluice valve that closes the aperture when the log proper is withdrawn. The valve is surmounted by a tube that has at its extremity a handle used in withdrawing the log.

The part of the log exterior to the ship's hull is a gun-metal supporting arm that has at its extremity a conical seating carrying a main bearing and shaft on which a vaned screw propeller is fixed. Through the inside tube and the outside arm an electrically insulated cable passes. The vaned screw, by means of worm gears, drives a commutator, or make and break disks, which is contained in the forearm. Running entirely through the apparatus and to the bridge of the ship, where the recording instrument is usually located, is a cable that carries current supplied by a dry battery. The action of the make and break circuit as it is affected by the revolutions of the vaned screw, reveals the speed of the boat.


INDICATORS ON BRIDGE
WIRE TO INDICATORS ON BRIDGE
HANDLE FOR WITHDRAWING APPARATUS
VALVE CLOSED WHEN APPARATUS IS WITHDRAWN FOR REPAIR
SHIP'S SKIN
APPARATUS SHOWN GREATLY ENLARGED

The electric log and its position in ship's bottom

Self-Holding Last for Shoe Repair at Home

A SELF-HOLDING shoe last, which makes it unnecessary for a cobbler to hold the shoe with one hand while working on it with the other, has been invented by John S. Butcher, of Vineland, N. J., for use by persons who repair their own shoes, as well as by professional shoe repairers.

The holder is equipped with three lasts, the smallest of which is used when applying heels. The shoe is placed in position and the rear brace locked, so that the cobbler has both hands free.

Human Kidney Is Complex Filtration Plant

MICROSCOPIC instruments of marvelous workmanship and the development of a very fine technic in handling them have made possible the discovery by Prof. A. N. Richards and Dr. O. H. Plant, of the University of Pennsylvania, that in the human kidney there is a microscopic filtration plant of extreme complexity.

The blood flows through the finely divided network of blood vessels in the kidneys to many thousands of microscopic filters, they find. The blood passes over the heads of these filters under considerable pressure; some water and waste products pass through them, ultimately being excreted; while the bulk of the blood passes back to the main blood stream.

Every increase in the amount of waste products eliminated is accomplished by increase in the pressure of the blood on these filters.

Electricity Makes New Wine as Mellow as Oldest Vintage

OF COURSE, this is out of date in America, but—a French professor, Dr. Charles Henry of the Sorbonne, Paris, France, has just perfected a method of aging wines by electricity!

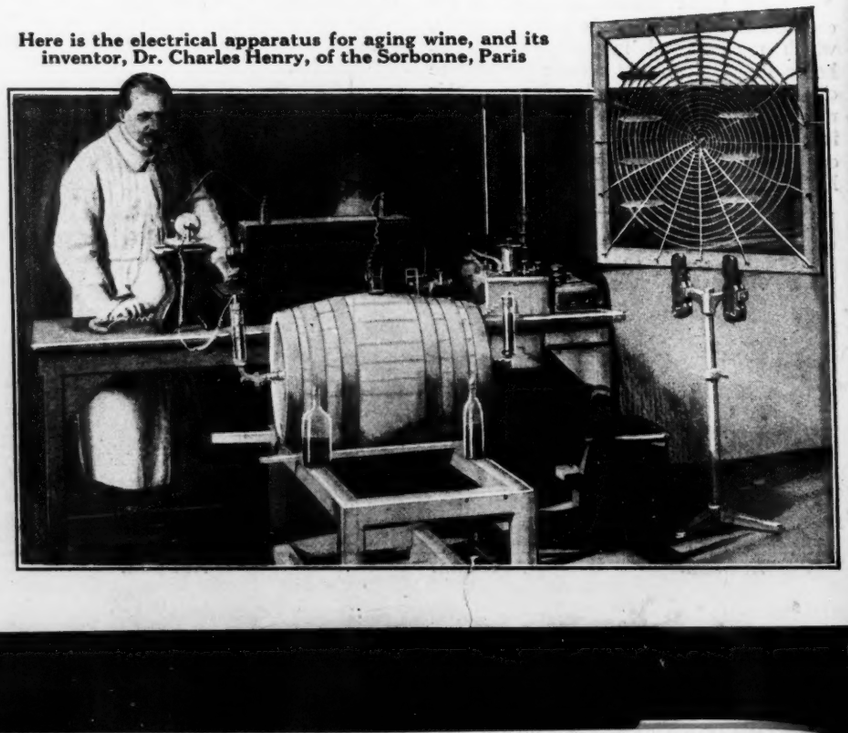
The usual process of aging consists of breaking up certain chemical compounds to form other compounds. The union of these chemicals with oxygen is necessary to bring about the change. In the time-worn method, oxygen is obtained through the pores of wooden barrels, and the process is a slow one.

On the principle that oxidization takes place at one of the terminals or electrodes of an electric circuit, Doctor Henry has equipped a wine-filled barrel with an anode and cathode having a difference of potential, or voltage, of from 60,000 to 120,000. The oxidization is very rapid—20 years of actual aging is accomplished, it is claimed, in a few hours. Experts claim that liquors aged by this process are equal in flavor to vintages aged by the years.

French experts believe, too, that electrical oxidization will eliminate the harmful effects of new liquors that so often prove injurious to drinkers because of the presence of certain poisonous bacilli. Electrical treatment is said to kill these decomposing bacilli, while permitting the formation of those harmless chemical combinations that give the beverage the mellow taste found in properly aged liquors.

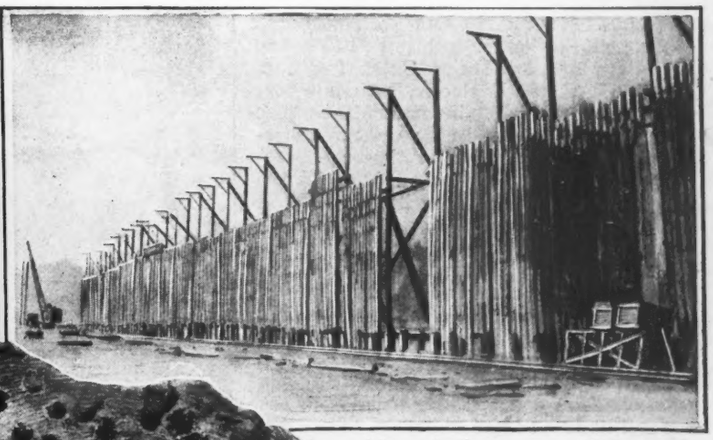
While physicians disagree as to the harmful effects on the body of alcoholic beverages that have not been allowed to age, recent analysis of 100 samples of liquors seized in West Virginia revealed that most of them were dangerous for human consumption because of the most objectionable forms of decomposition found in them.

Here is the electrical apparatus for aging wine, and its inventor, Dr. Charles Henry, of the Sorbonne, Paris



Concrete Armor to Protect Piles from Borers

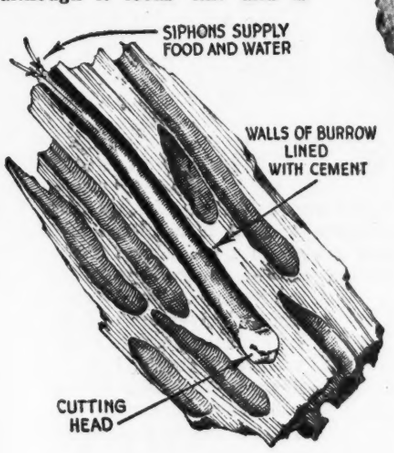
Covered with steel mesh reinforcement, the wooden pipes are sprayed with concrete from cement guns

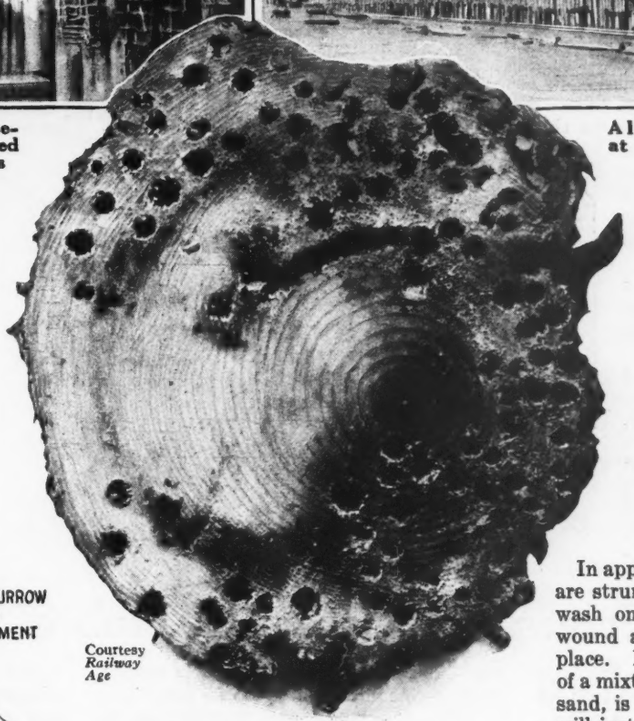


A line of piles strung on framework at Tacoma, Wash., to receive a coating of concrete armor

INCASING piles in a two-inch coat of reinforced concrete armor has solved the problem of preventing the destruction of docks and wharves by the teredo and other boring mollusks, according to the statements of eminent engineers.

The teredo, which is the most dangerous and the most prolific of these borers, is a mollusk, although it looks like and is often erroneously referred to as a worm. It lives in burrows that it drills into submerged timbers with sharp cutters at the front end of its shell. These burrows are made just deep enough to permit the teredo to leave a siphon-like tube extending outward into the water. Through this siphon the teredo draws water containing the minute food particles upon which it lives.





Courtesy *Railway Age*

Section of wooden pile honeycombed by boring teredos, as shown at left

By the boring action of the shells the wood is reduced to an extremely fine powder, which, although often found in the animal, is not part of its food.

For some time creosoting has been used as protection. While successful against some types of borers, it has many drawbacks, chief of which is the fire hazard.

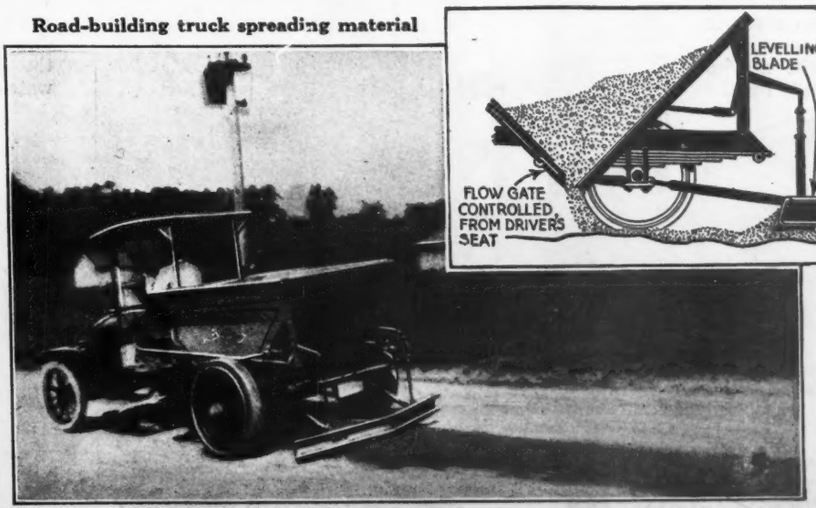
In applying the cement coatings, the piles are strung on framework in the open, like wash on a line. A woven steel mesh is wound around the wood and fastened in place. From squirt guns concrete made of a mixture of one part cement to two parts sand, is shot against the surface so that it will just cover the mesh. After drying, another coating is applied, increasing the thickness of the concrete to two inches. Only the upper portion of the pile is coated, for the part driven into the ground requires no further protection. Tests prove that borers cannot penetrate a two-inch concrete armor. In addition, the concrete covering serves as a resistant to fire.

Automatic Road Building Truck Spreads Gravel Evenly

FOR highway maintenance work, a truck with a hopper body and adjustable scraper, recently placed upon the market by an Ohio concern, transports and automatically spreads gravel or other road material without the aid of hand shoveling.

The truck has a capacity of three tons of material and is constructed in the shape of a hopper, with a long narrow sliding gate forming the front sloping side of the body By opening this gate, the driver from his seat controls the flow of material from the hopper and thins the depth to which the material is deposited on the road.

Road-building truck spreading material



By opening a flow gate in the hopper, the driver controls the flow of material, as shown in diagram. An adjustable blade levels material

An adjustable scraper attached to the rear axle and also controlled from the driver's seat, aids in spreading the material and levels it over chuck holes and deep ruts in the road.

The machine travels at a rate of from 12 to 15 miles an hour and it is claimed that it equals the amount of hauling ordinarily requiring six teams and wagons.

The truck also is used to pull light road graders.

Portable Jointed Tube Bridge Travels on Wheels

AN EXTRAORDINARY portable bridge, built of interchangeable tubes and designed by Major C. E. Inglis, of the British Royal Engineers, is finding considerable peacetime use because of its extreme lightness, strength, and easy and rapid erection across a river or impassable gorge.

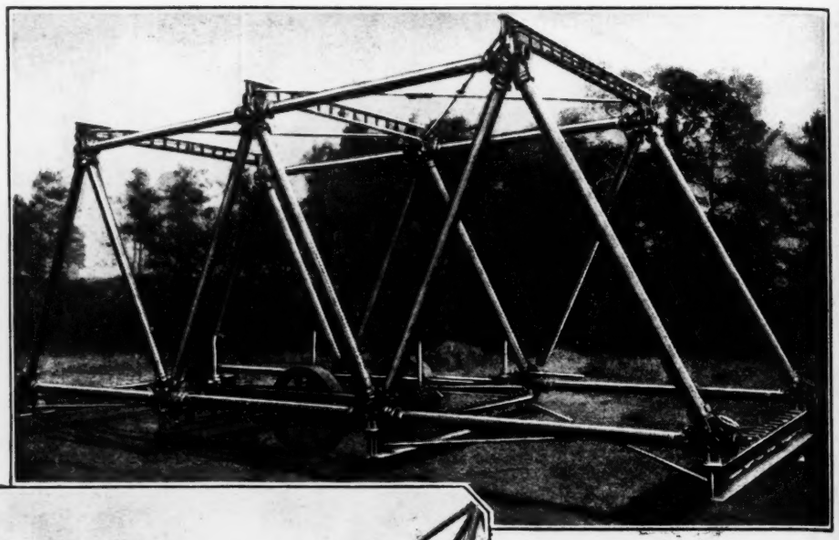
The bridge may be erected either at the site or, a 100-foot span can be erected on a two-wheeled trolley and wheeled to its destination.

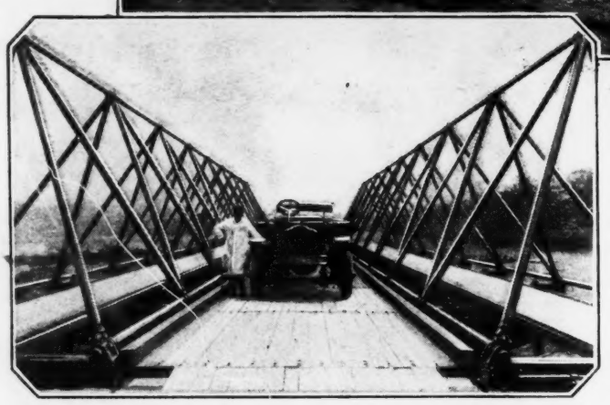
In each of several standard types all the girder members consist of interchangeable tubes of the same length and size. The floor transoms are interchangeable as are the joints to which the tubular members are attached.

In the lightest type, main girder diagonal members form equilateral triangles with the top and bottom flanges or booms. The bracing members are on such an angle that a single line of tubing serves as the top boom. Floor transoms or cross girders may be of timber or steel, and are bolted to plates that form part of the cast steel joints.

To the end of each tube a steel eye end is screwed and on this eye end a collar or nut is screwed.

The joints into which the tubes fit are formed with circular sockets all of the same diameter, set at angles to receive the eye ends of the tubes. As each end is inserted, a pin is slipped through holes in the tube and socket and the collar is screwed up, fastening the joint. Longitudinal timbers are laid on the transoms to form the footwalk or roadway.





Above: Portable bridge assembled on wheels. At left: Two foot bridges joined to support a roadway between them

A span of 96 feet weighs 2½ tons and will carry a distributed load of 6 tons.

The triangular type may be used upside down to form a deck bridge, the flooring being laid along the top.

How Movie Screen Shows Heart Throb of Embryo Chick

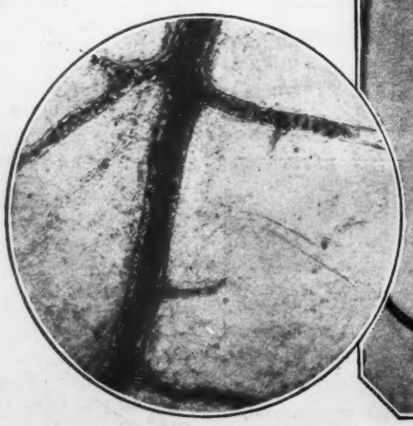
WHAT the motion picture has done in depicting the operations of human life, it now promises to do in portraying invisible, microscopic life in action.

We can now watch on the screen the rhythmical action of the living heart of an embryo chick. We can see the movements of millions of tiny blood corpuscles as they flow through the veins. Or, we can watch the marvelous development and growth of a fish from its very beginnings as each minute change is faithfully recorded, enlarged some 120 diameters, on a movie film.

Such wonders of the movies have been made possible by the recent development of microscopic movies, or microcinematography, which may revolutionize the study and teaching of biology.

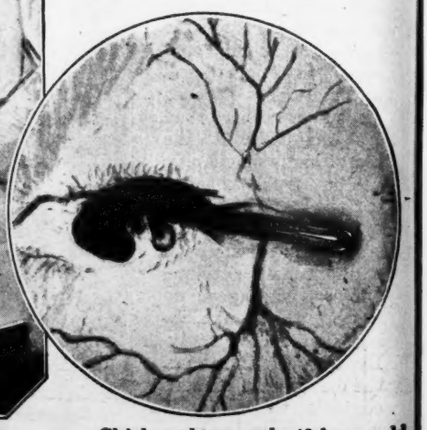
The apparatus used for the making of microscopic films is a special rigid table and a vertical mechanism by which the camera can be lowered or raised automatically. A clockwork mechanism for movement of the film not only makes possible exposures at various intervals, but turns the lights on and off a second before and after the exposure is made. Thus stages in development of a certain subject over a long period can be photographed on a reasonably long film, the machine making the exposures without the intervention of human hands.

The camera is equipped with a direct focus tube through which the image on the film can be watched during exposure.



Blood particles swarm through the veins

Cinema camera apparatus for microscopic movies

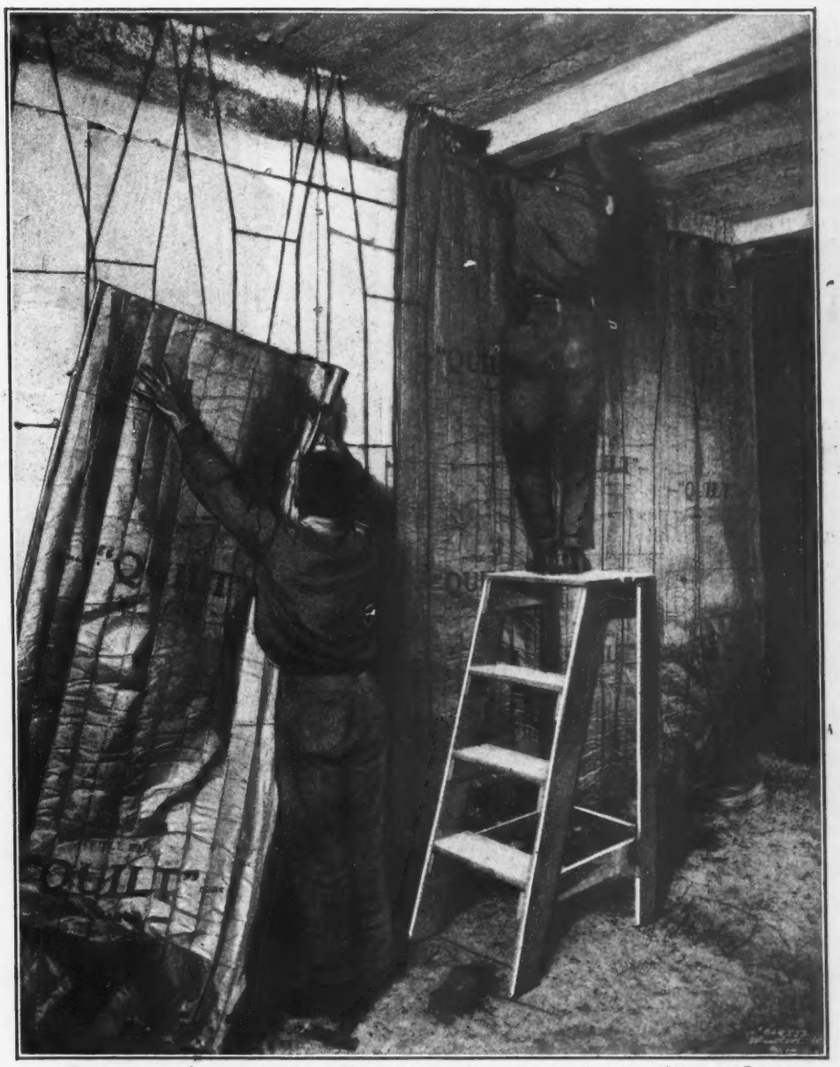


Chick embryo, only 48 hours old

Three-Inch Apartment Walls Keep Out Noise

CONSTRUCTING partition walls only three inches thick for apartment houses so that they are soundproof and fireproof even though extremely light, is a problem that has been solved in the building of one of New York's most modern apartments, by the use of eel grass quilt hung behind vertical wires that are strung from ceilings to floors.

The quilt is a felted matting of cured eel grass inserted between two layers of exceedingly tough paper or asbestos—and stitched with strong thread. It is said to be proof from decay, fire, and vermin.



Fastening eel grass quilt walls behind wires strung from ceiling to floor

Plaster Boards Help Kill Sound

The wires serve, not only to support the quilt, but also to deaden sound by absorbing vibration. Their arrangement is such that, after they are pulled taut, the eel grass quilt can be fastened between sets of the wires. Gypsum plaster boards, which also serve to deaden sound, are then placed on each side of the quilt and fastened to the wires with clips. Over the board, a final plaster coat is applied on each side to finish the wall.

Eel grass grows in salt water and contains considerable silicon in place of the carbon found in plants that grow in the air. This makes the grass practically fireproof, protects it from rats and other vermin, and preserves it from decay. Specimens of the grass are known to have been preserved in the air for 280 years.

Constant Noise Is Injurious

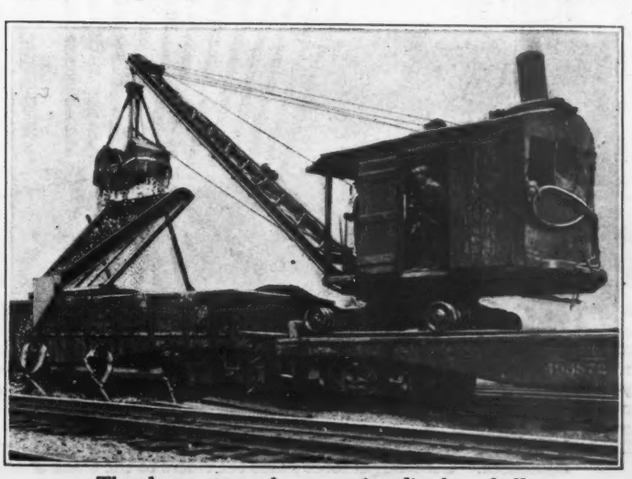
The problem of making buildings comparatively soundproof has been a subject of extensive scientific investigation. It has been found that the nerves of our ears are partially paralyzed by the fatigue effect produced by noisy surroundings, and that if the noise is continued over a period of years, the fatigue extends through the entire body. This, of course, is one of the reasons that people in general demand quiet rooms in their apartments during their rest hours.

Elaborate researches that were undertaken by the University of Illinois Engineering Experiment Station established the fact that soundproof partitions must be as free as it is possible to make them from air passages, and that absorption of sound is the essential factor in soundproofing, since reflecting sound simply scatters it and leaves it with energy. What really happens when sound is absorbed is that it is converted into heat energy by friction. The new eel grass walls possess this quality of sound absorption.

Clamshell Bucket and Screen Clean Ballast along Railway

THE cinders, dirt and other foreign matter that clogs rock ballast under railroad tracks and so retards drainage along the line is being successfully removed by means of an ingenious mechanical ballast cleaner operated by a large Eastern railroad. The outfit includes a clamshell dredge, mounted on a flatcar, that picks up the uncleaned ballast from the roadbed, and pours it on a screen that sifts out the dirt and cinders.

The screen is placed at an angle over a gondola car in such a way that the clamshell bucket can discharge a load of old ballast near the top. As the material rolls down the incline, the dirt falls through the screen so that the remainder, which reaches the spout at the lower end, is made up of large clean stones only. Thus a load of rock ballast is cleaned and immediately deposited on the spot from which it was originally removed.



The cleaner at work—screening dirt from ballast

The jaws of the clamshell are equipped with long teeth so that while the ballast is removed to a depth of only a foot, the subsoil is stirred up six inches below this level. This assists drainage greatly, since it provides a deep porous layer between rail lines.

About Inbreeding

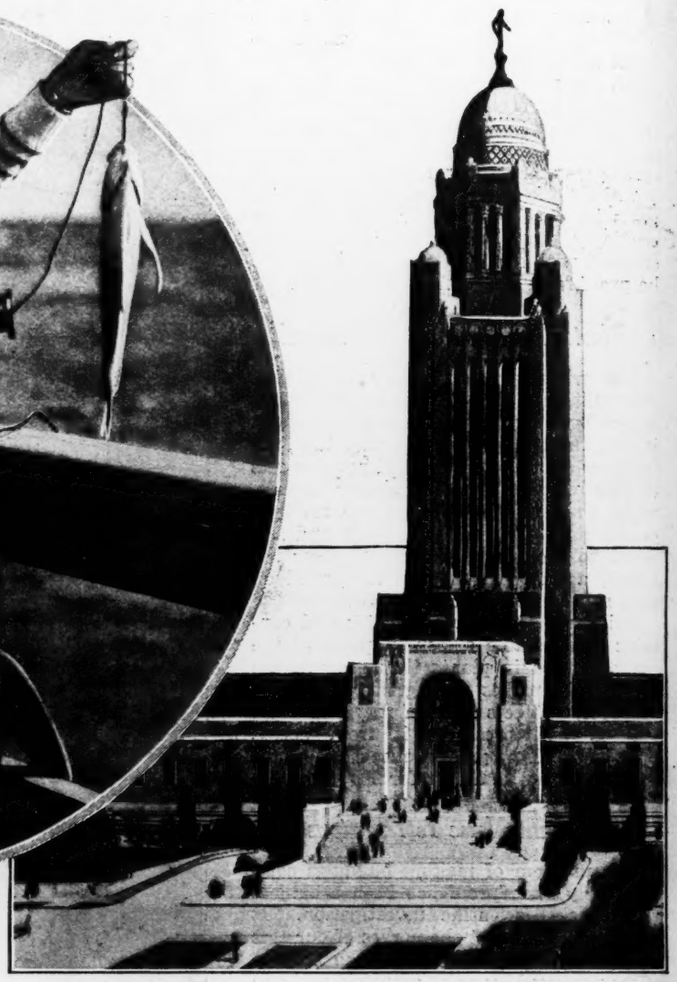
THE general belief that the intermarriage of related individuals tends to produce low grade mentalities and inherent physical defects in offspring is contradicted by recent investigations carried on by the United States Department of Agriculture, Husbandry Division.

Inbreeding and cross breeding of guinea pigs showed that inbred families produced comparatively few abnormal individuals.

Motorized Fish Reel Leads Month's Novelties

©U. & U.

If you're the kind of fisherman who doesn't like to struggle with the line when the big ones bite, this electric motor reel, introduced at Palm Beach by Miss Florence Sullivan, Chicago society girl, ought to fill the bill. When Florence gets a bite, all she does is turn a switch and, presto!—there's the fish. A small electric motor does the trick



A massive domed tower 400 feet high—nearly as high as the Washington Monument—will form the bulk of the most unusual state Capitol in the United States, at Lincoln, Neb. Rising from the center of a square, two-story structure, the tower will house state offices. Light is provided for every room in the building by means of courts within the structure

No coal shortages nor slow elevator service worry the family that lives in this neat little South African villa built of mud and covered by a thatched roof. An African boy is shown above crawling out of the doorway—a small porthole in the side

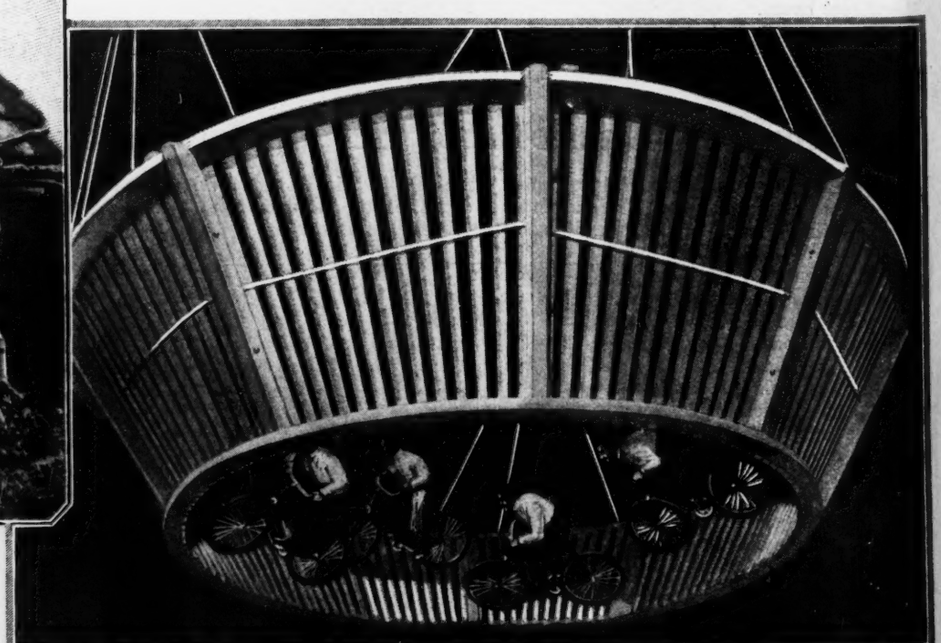


Photo courtesy *Die Woche*

Latest circus stunt—A bicycle race around the banked sides of a bottomless basket is thrilling German audiences. Centrifugal force holds the riders to the track as the basket is raised from the stage floor

Blizzard Warnings from the Arctic

This chart shows the breeding ground of many of our worst blizzards, which are born in the Behring Sea and may travel for 15,000 or 20,000 miles along the path indicated by the dotted line. The crosses indicate proposed arctic weather stations and the circles existing stations

A CHAIN of arctic weather stations surrounding the North Pole, some of them on ships afloat in the polar seas and all of them in daily communication by radio with the rest of the world—this is the next advance in weather forecasting how being urged upon government officials in Washington.

Many of our worst storms are born unobserved on what is called the "arctic frontier," thousands of miles away from the populous regions which they later assail. Today only one weather station exists in this frigid breeding ground of blizzards. It is on the remote island of Jan Mayen, off the eastern coast of Greenland. Helpful as reports from this farthest north weather station are, really accurate forecasts of the winter's worst storms will not be available until the entire arctic is circled by similar stations.

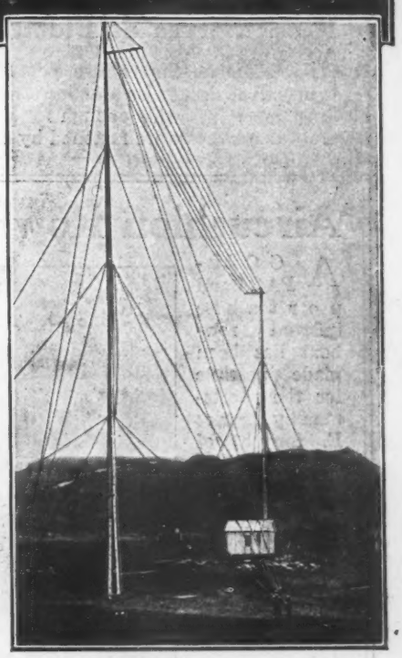
The cooperation of America in erecting such a string of stations is now being sought by Professor V. Bjerknus Ekerold, distinguished Norwegian meteorologist, who helped establish the Jan Mayen Island station.

Professor V. B. Ekerold

He explains the "arctic frontier" as a belt that follows the general line of the Arctic Circle around the world. Here the cold air from over the ice caps meets the warmer and moister air from the oceans to the south. When these bodies of air of different temperature and humidity come together, great storms are formed that sweep for thousands of miles over oceans and continents.

It would be comparatively simple to establish stations on land for far north weather observers, he says, but in some cases the stations would have to be maintained at sea by anchoring ships along the line of the arctic frontier. Or it may be that certain areas would be covered by specially designed cruising weather ships.

If the plan to establish this frontier guard is adopted, forecasters of all nations will have several days' warning of approaching storms.



The world's Farthest North weather and wireless station, located on Jan Mayen Island (see chart), 400 miles northeast of Iceland. This station is expected to be the first in a chain that will encircle the arctic and give radio warnings of storms to weather observers of all nations several days in advance of the storms

Sliding Celluloid Windows Convert Open Car into Sedan

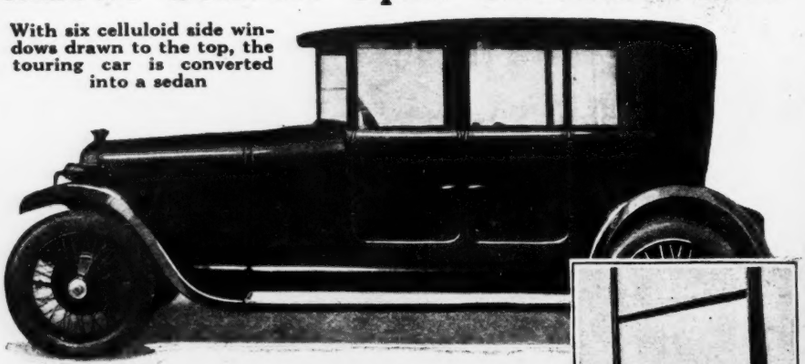
CELLULOID windows that instantly convert an open touring car into a closed car have been installed in a new English all weather model that recently appeared on the market. When the automobile is used as an open car, the windows disappear into pockets in the doors and sides of the tonneau.

The celluloid window, which is made of very clear transparent materials, is mounted on a frame that slides vertically in and out of the pocket. The frame runs on guide strips that swing up on hinges at each side of the pocket. When the window is lowered and the strips are swung down into the pocket, a small hinged door on the inside closes over the top of the pocket, completely hiding the contents.

Car Is Completely Inclosed

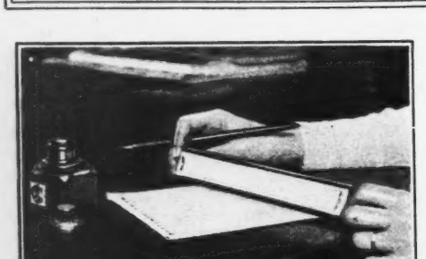
One of these window devices is provided in each door of the car and also on each side of the back seat, so that when the windows are raised and the hood is up, the car is completely inclosed.

The windows can be lifted to any position and can be used as side windscreens without the top. The guides are slightly curved so as to permit the disappearance of the windows into the pockets. The doors are operated from the inside by pressure on a pedal, thus eliminating handle catches that might interfere with the operation of the window.



With six celluloid side windows drawn to the top, the touring car is converted into a sedan

At right: Window half raised. Below: Window pocket with guide strips lowered



Ruler Serves as Blotter

MOUNTED on the reverse side of an ingenious desk ruler are nine strips of blotting paper just wide enough for a signature. The blotters are fastened by clips.

Colors Fused into Glass by New Process

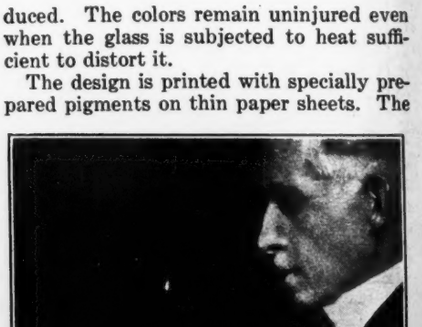
STAINED glass windows that usually cost many thousands of dollars can be made cheaply, and labels of any color can be imprinted on glass bottles at a cost less than that of printing them on paper, it is claimed, as the result of a recent invention of a new method of glass manufacture by Kalman Warga of New York.

After studying and practising glass production for many years in Bohemia, Austria, Turkey, and America, Warga conceived the idea of applying the art of china painting to glass, with the result that he can print upon unannealed glass and burn the print into the glass during the annealing process in such a way that the most pleasing color combinations are permanently produced. The colors remain uninjured even when the glass is subjected to heat sufficient to distort it.

The design is printed with specially prepared pigments on thin paper sheets. The paper is then glued upon the glass in its proper position. The glassware is next placed on continuous belts, which carry it a distance of from 75 to 90 feet through an annealing furnace. During the journey the temperature in the furnace is gradually raised to a maximum and then lowered. The high temperature reached is sufficient to consume the paper and the glue, while causing the printing pigments to fuse with the glass.

The print is thus integral with the glass and is as enduring as the glass itself.

It is easy to appreciate that this invention will be popular with manufacturers of trade-marked bottles, etc.

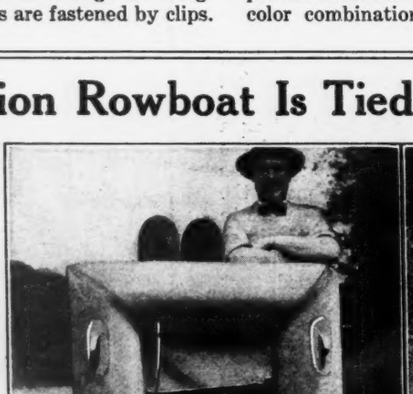


The glass bottle has been distorted by heat without injury to label

Aircushion Rowboat Is Tied in Bundle

A COMPACT and portable inflated rowboat has been made possible for the sportsman by Charles F. Smyth, of New Haven, Conn., who has devised a craft, soft as a pneumatic mattress, by attaching four inflated cylinders to a waterproof fabric bottom.

The four inflated cylinders, made of rubberized fabric, are connected, but inflated singly.

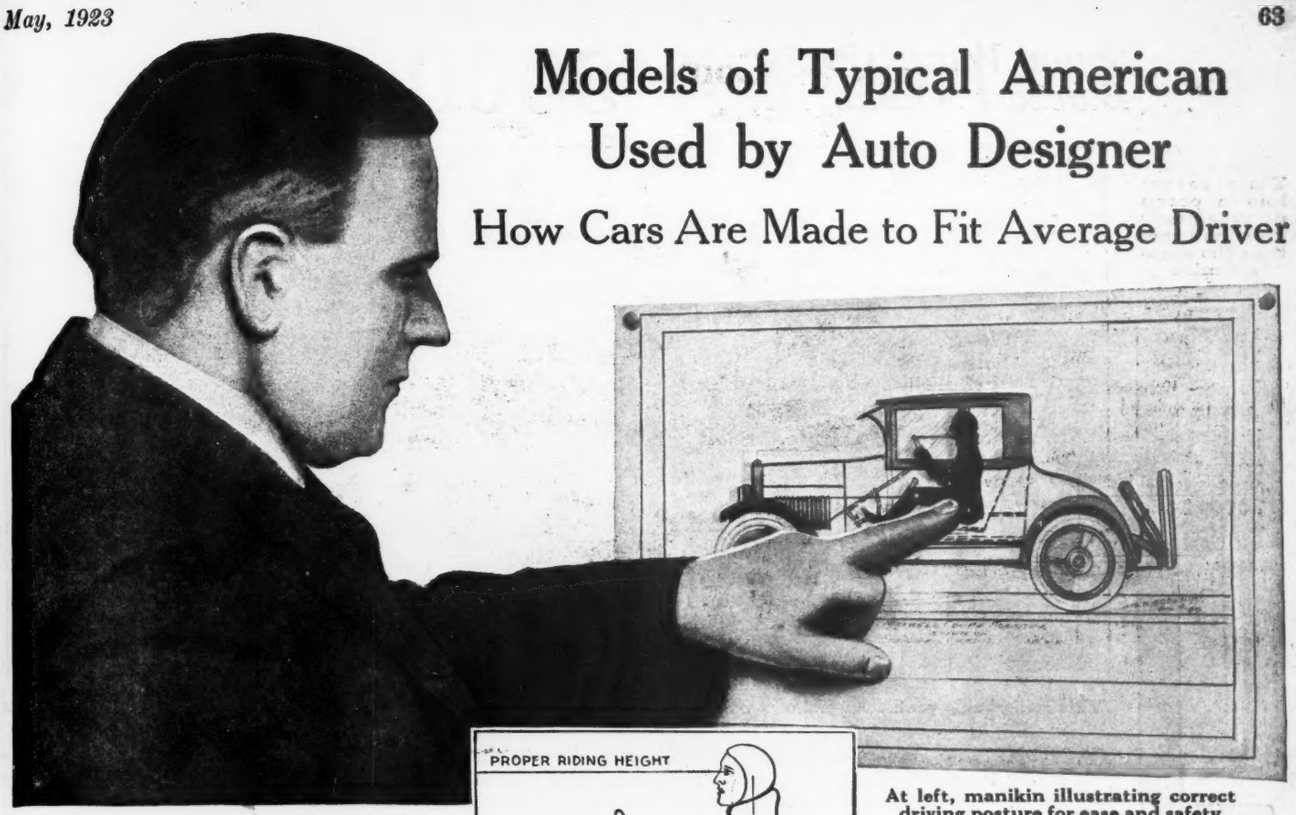


The complete rowboat inflated

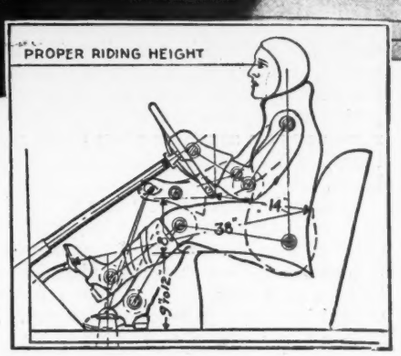
Rolled in a bundle

Models of Typical American Used by Auto Designer

How Cars Are Made to Fit Average Driver



Above, E. W. Goodwin, demonstrating use of manikin in auto design



At left, manikin illustrating correct driving posture for ease and safety

SMALL celluloid manikins, representing exactly the physique of the average American, are now being ingeniously used by automobile designers to ensure for driver and passengers the maximum comfort and convenience in each new model they turn out.

Use of the manikins was originated by E. W. Goodwin, body designer for one of the largest automobile manufacturers. In order that these celluloid models should have a typical American figure, Goodwin constructed them according to the average proportions determined from measurements of 100,000 American soldiers. They are so jointed as to conform to any normal position of the motorist.

As each new model is being developed on the drafting board, the manikins—made to the same scale—are frequently placed upon it to check the various dimensions affecting riding or driving comfort. There are innumerable points at which such a check is necessary—the height of seat and cushions, for instance, or the slope and height of seat back, location of steering wheel, distance to pedals and levers, line of vision through windshield, distance from floor to top, etc.

Goodwin also uses his manikins to illustrate correct driving posture. This erect position, as shown in inset drawing, should be conformed to for safety and comfort.

Novel Shockproof Wheels Lengthen Life of Motor Truck

MUCH of the road jar that tears at the chassis of the average motor truck, shortening the life of the car, is said to have been eliminated by a new and unusual shockproof wheel mounted on two flexible cone hubs. The use of the wheels, it is claimed, will greatly increase tire mileage.

The mounting is based on the principle of the cone clutch with 45-degree faces. The male cone, or hub, is slidably mounted on the axle hub, while the female member is attached to the wheel. These two are kept in contact and centered by a heavy steel spring, which forces the male member outward against the wheel cone.

When a bump is encountered and the wheel is suddenly shot upward, the inner or axle cone slides out of contact with the wheel cone and is forced against the action of the spring. Thus the spring acts as a cushion and later will restore the cones to the central contact position.

Further, when power is applied to the inner hub, this force is transmitted to the wheel through the spring, and the result is a gradual application of power to the wheel rather than a jerk. When the truck is finally moving, the spring restores itself to its original shape and the friction of the cones on each other serves to transmit the tractive effort.

A high tire mileage is obtained, since the only unsprung weight is that of the wheel and the tire. All other weights are cushioned by springs that serve to take up the sudden loads that wear out tires.

It is claimed that the new method of wheel mounting will more than double tire mileage, at the same time increasing the maximum speed of the truck.

The new shockproof wheel is especially adapted for use on fire trucks, where high speed combined with easy riding qualities is desired.

For added speed, this fire truck is equipped with shockproof wheels

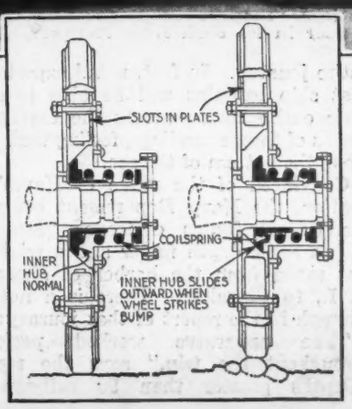
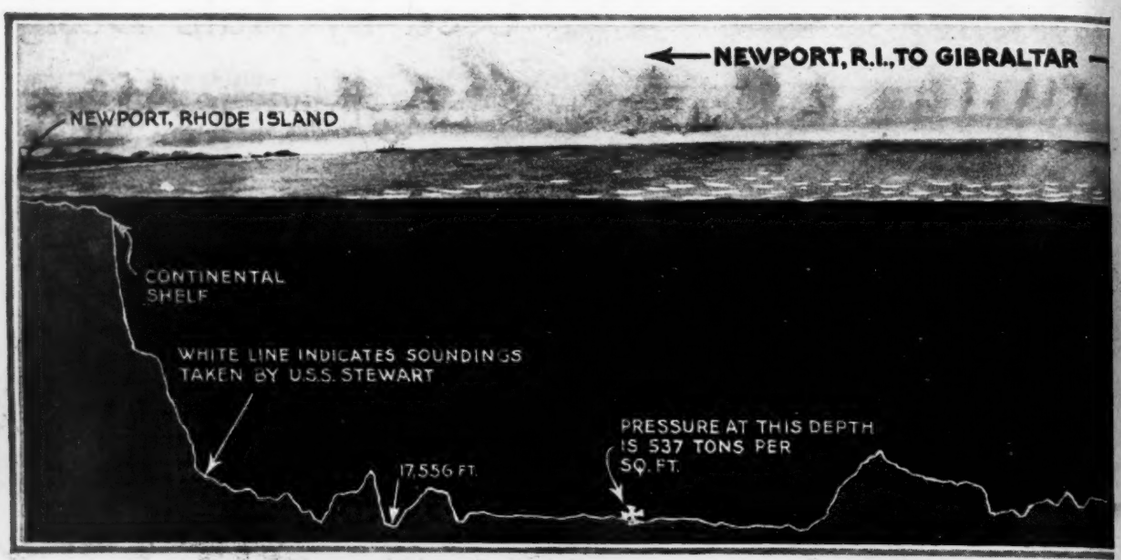


Diagram at the left shows wheel mounting and operation of hubs

Sound Waves Probe the Blackest Ocean Depths

5000 Fathoms

The greatest known ocean depth is nearly five miles deeper than the deepest mine


NEWPORT, R.I., TO GIBRALTAR
NEWPORT, RHODE ISLAND
CONTINENTAL SHELF
WHITE LINE INDICATES SOUNDINGS TAKEN BY U.S.S. STEWART
PRESSURE AT THIS DEPTH IS 537 TONS PER SQ. FT.
17,556 FT.

This remarkable profile map shows the mountains, ravines, plateaus, and plains of the Atlantic Ocean bed from

SCIENCE, by measuring the speed of sound waves in water, is wresting from Davy Jones all the secrets of his locker—the mysteries of uncharted ocean valleys, submerged volcanoes and mountains, abysmal caverns and hills. With one gesture mankind is able at last to penetrate "bottomless" holes and to replace age-old guess and tradition with a faithfully accurate map of the bottom of the sea.

For centuries man has sought to learn exactly the precise form taken by the bed of the ocean; to find out—for example—what became of the lost continent, Atlantis; to know more of "Nero's hole," that cavern of the Pacific that sailors have declared has no bottom; to be able to tell accurately how deep the ocean is at any given point; in short, to know without any question what a raised map of the ocean drained dry, would look like. For centuries sea explorers were baffled. At tremendous expense, an enormous output of energy and time, they made many thousands of soundings by the simple expedient of dropping a lead attached to a cable. This, of course, was so difficult, so inefficient, that comparatively little was found out concerning the contour of the ocean's bed.

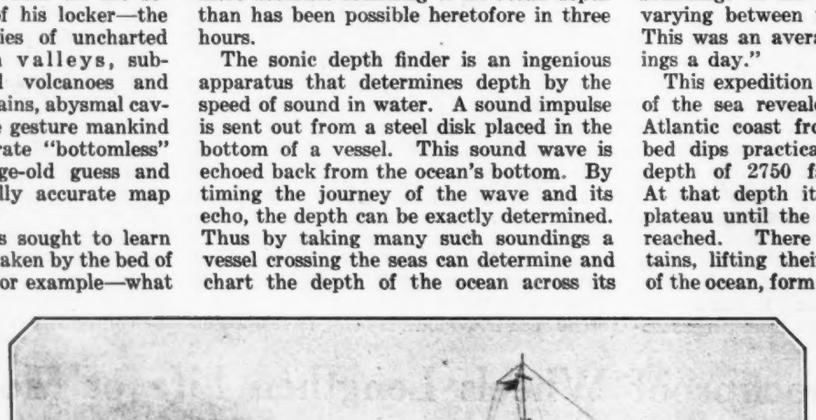
War came; and the submarine. Nations found it necessary to detect the approach of a submarine even though it might be fathoms below the ocean surface. The submarine detector resulted—a device that not only detected sound waves traveling through the water, but determined approximately the distance they had traveled. And, out of the war, came a remarkable new peacetime sounding device—the sonic depth finder—which, according to the inventor, Harvey C. Hayes, physicist, of the United States Naval Engineering Department, will in four minutes make a far more accurate sounding of an ocean depth than has been possible heretofore in three hours.

The sonic depth finder is an ingenious apparatus that determines depth by the speed of sound in water. A sound impulse is sent out from a steel disk placed in the bottom of a vessel. This sound wave is echoed back from the ocean's bottom. By timing the journey of the wave and its echo, the depth can be exactly determined. Thus by taking many such soundings a vessel crossing the seas can determine and chart the depth of the ocean across its entire journey. In fact, naval experts say that ship captains will be able to steer their entire course across the oceans by means of these soundings, feeling their way along the bottom of the sea.

Convinced of the value of Hayes' invention, the Navy Department equipped the United States destroyer "Stewart" with a sonic depth finder and a trial trip was made from the harbor of Newport, R. I., to Gibraltar. There is a note of triumph in the report of that journey:

"The apparatus worked perfectly throughout the trip," says the report. "Depths greater than 90 fathoms (a fathom is six feet) were taken with the sonic depth finder by measuring the time required for sound signals to travel to the bottom of the sea and return. About 900 soundings in all were taken, for depths varying between nine and 3200 fathoms. This was an average of about 100 soundings a day."

This expedition for charting the bottom of the sea revealed that directly off the Atlantic coast from Newport, the ocean bed dips practically straight down to a depth of 2750 fathoms, or 16,500 feet. At that depth it undulates like a great plateau until the vicinity of the Azores is reached. There huge undersea mountains, lifting their peaks above the level of the ocean, form the islands of the Azores. These mountain ranges may, at one time, have formed the lost continent Atlantis. From the Azores the ocean bed then dips down to the lowest depth reached on the trip, 9200 feet, rising again to form the European continent and Gibraltar.



United States destroyer "Stewart" mapping mountains and valleys of the Atlantic Ocean floor in its dash from Newport, R. I., to Gibraltar

The success of the destroyer "Stewart's" expedition in discovering fascinating new secrets of the ocean depths, led to still further achievements.

Two more United States destroyers, the "Hull" and "Corry," are now engaged in the thrilling task of charting the Pacific, just as the Atlantic has been charted.

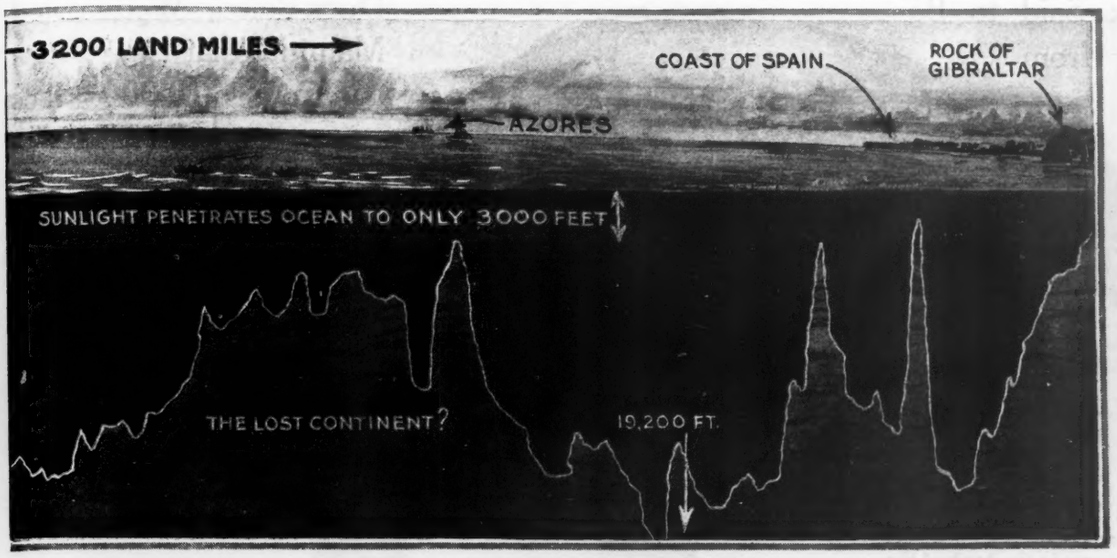
Already, with the aid of the sonic depth finder, they have discovered an uncharted mountain range 100 miles off the Pacific Coast, southwest of San Diego, Calif. One peak of this range is more than 1600 feet high. Another important "find" was proof that the floor of the Pacific Ocean off the California Coast had not been disturbed in recent years by volcanoes or earthquakes as was popularly believed.

When the Pacific has given up its hidden mysteries, other seas will be charted, until

Sonic depth finder

Under the Sea

How U. S. Destroyers Chart Atlantic Floor



Newport, R. I., to Gibraltar, as accurately charted by U. S. destroyer "Stewart," using sound waves to measure depth

The highest airplane altitude record is little higher than the ocean is deep

at last we shall know accurately the contour of the entire bottom of the sea—*71 per cent of the world's surface, or about 141 million square miles.*

Curiously enough, although we have never been able to penetrate the farthest depths of the ocean, we know a great deal concerning them. We know, for instance, that the average depth of the sea is about 2½ miles, and that only 16 per cent of the ocean floor lies at a depth between the shore line and 6000 feet. We know that the deepest holes probably are in the Pacific—the "Swire deep" of 32,088 feet, or about six miles, off Mindanao Island in the Philippines, and the "Challenger deep" of approximately the same depth.

Heat rays are lost at about 250 fathoms, and even in the tropics the upper stratum of warmish water is comparatively thin. The great bulk of the water in the oceans is relatively cold. At depths of 300 feet it is probable that the temperature does not change as much as two degrees at any place and that below 600 feet there is no temperature change. It has been estimated that 87 per cent of the entire amount of water in the ocean has a temperature below 40° F., and in the great depths it is undoubtedly just a little above the freezing point.

An idea of the tremendous pressure at great depths may be gained from the fact that when a piece of wood is weighted and lowered to a great depth, then pulled up again, it will no longer float; that if a corked bottle not quite full of water is lowered, either the cork will be pushed into the bottle or the bottle will crack. Watertight compartments in lowered bodies collapse after they reach great depths.

The Earth's Three Divisions

Scientists distinguish three great areas of the earth's surface—the continental area (that above the sea's surface); the continental slope, from the shallow shelf of the continents down to the bottom of the sea (including about one sixth of the total superficial area of the globe), and the abysmal area, a prodigious plane at the depth of the sea, including about 100 million square miles.

In the shallower water, the nature of deposits on the floor of the ocean varies from place to place, according to the nature of the shore rocks. There are gravels, sands, muds, and masses of organic matter. But on the floor of the abysmal depths, there is an accumulation of fine grained ooze consisting very largely of the remains of minute organisms that have sunk from the surface.

Strangely enough, there is probably far more living matter in the sea than on the dry land of the world. The sea is abundant in weird fish, shellfish, sea grasses, strange luminous plants, organisms of every imaginable variety. Concerning these we still have much to learn. But in our knowledge of these living creatures we have progressed far in discovering the exact contour of the land in which they live.

Many Machine Tools Combined in Electric Hand Drill

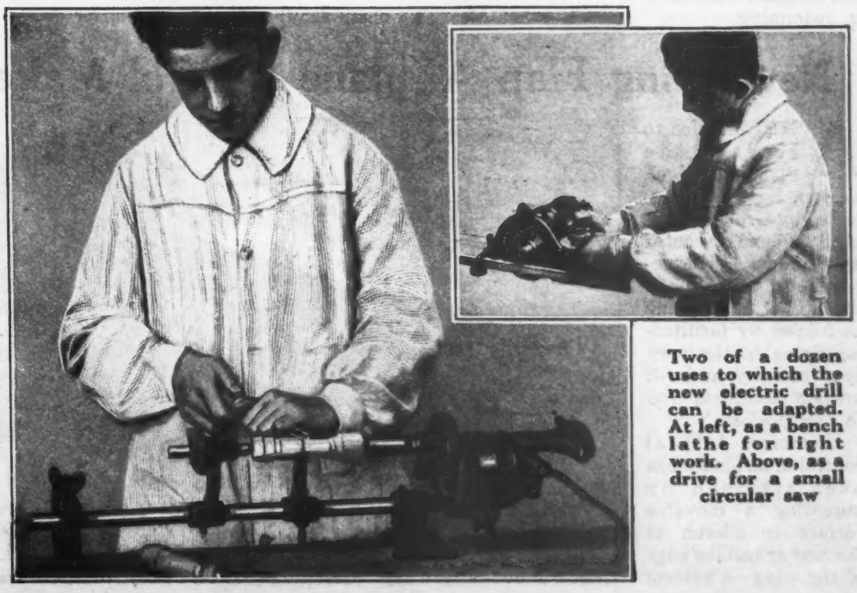
COMBINING more than a dozen machine tools in one, an electric hand drill of recent invention is adapted for a wide variety of light work in the small workshop, home, or farm. Its most valuable uses are as a turning lathe, a circular saw drive, and a grinding machine.

When it is to be used as a lathe, the drill is screwed to a bed fastened to the workbench, upon which is also screwed the tailstock and toolrest. For small wood work the improvised lathe is excellent.

When a Drill Is a Saw

For use as a saw, the drill is fastened to a guide and a small circular saw is screwed to the rotor. The guide is equipped with flanges that project over the sides of the wood to be sawed, and the drill is moved forward by hand. A blade follows in the saw cut to keep the saw in alinement.

The machine can be adapted to drive a milk separator, to cut turnips, clean corn, sort potatoes, and, when a grindstone replaces the saw blade, as a tool grinder.



Two of a dozen uses to which the new electric drill can be adapted. At left, as a bench lathe for light work. Above, as a drive for a small circular saw

World's Queerest Animal Shown in Zoo

Furry Freak Said to Be a Left-Over from Dim Ages

Duck-Billed, Web-Footed Mammal that Lays Eggs, Comes 10,000 Miles

The only duck-billed platypus that ever lived in captivity outside Australia. Notice the bill and flat tai

Courtesy N. Y. Zoological Society

TRAVELING in an extraordinary "Pullman" cage built as an artificial replica of its home in the bank of the Namoi River, New South Wales, the strangest creature in the world—an Australian duck-billed platypus—recently was transported alive for 10,000 miles across the Pacific and the American continent to the New York Zoological Park. There it lived for 49 days, amazing immense throngs by its peculiar appearance and habits.

The "impossible" creature is declared to be a survival from prehistoric ages. It is a strange blend of mammal and water bird. Like a duck, it has a great wide, flat beak attached to its furry nose by a leathery cap. Like a duck, too, it has webbed feet which it uses in swimming or walking on land. The feet are armed with long claws.

It lays eggs—lots of them. Yet strange to say, it suckles its young with milk. It lives in rivers, but sleeps in burrows in the banks. It feeds on angle worms, grubs and very small shrimps.

The body of the little creature is covered with heavy dark brown fur and is about 1½ feet long. Its broad, flat tail, heavily haired, is used as a sort of rudder in swimming.

Head Keeper John Toomey, of the New York Zoological Park, showing the furry little creature to New York children, after its 10,000-mile journey from Australia

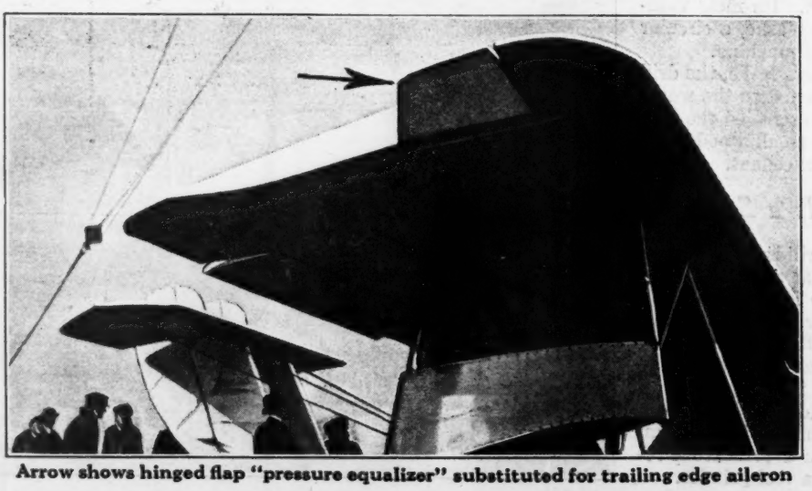
The ingenious 10-foot cage in which the platypus made its long journey had more compartments than a Pullman car. In the midship section was a large tank of water 18 inches deep, in which the animal swam round and round. On the forward "main deck" was an elevated pool that served as bathroom, flanked on each side by small sandbanks. The "quarter deck" contained a labyrinth of narrow hallways connected by burrows fitted with rubber gaskets to scrape the water off the animal's body as it wriggled through. In one corner was a bedroom burrow, where the little fellow slept in a nest of dry hay.

Thousands of these extraordinary looking animals have been killed by fur hunters in Australia.

New Wing Flap Airplane Control Makes City Flying Safer

A NEW device to replace the "trailing edge" aileron, has been perfected by Grover Loening, airplane inventor and builder. He declares it will widen the scope of airplane usefulness by facilitating flying in the very heart of a city, and will prevent accidents due to "air pockets."

Heretofore lateral control of airplanes has been attained by mounting a movable surface or aileron at the rear or trailing edge of the wing—a system that has proved unsatisfactory because it puts twisting stresses on the wing in such a way as to neutralize the aileron control.



Arrow shows hinged flap "pressure equalizer" substituted for trailing edge aileron

Loening's device, known as a "pressure equalizer," consists of a flap hinged to the side of the wing behind an extension of the wing tip and controlled by the pilot. Since it is in front of the wing center, the pressure equalizer tends to lift one side of the wing, increasing the angle of incidence and amplifying the control.

To Broadcast Baseball by Radio Movies

Action Photos of World Events to Be Flashed on Distant Screens

MOTION pictures of world events, broadcasted by radio and thrown simultaneously on screens in all parts of the world immediately after they happen!

This is the prediction of C. Francis Jenkins, a successful Washington, D. C., inventor. Jenkins has perfected an apparatus that transmits photographs by wireless for a distance of several miles, and he plans to improve his machine so that movies may be sent by radio at the rate of 16 a second.

When this astonishing achievement is accomplished, it will be possible to "shoot" movies of a baseball game into the ether as it is played, by transforming photographic impressions into radio waves, then to pick up these radio waves in far distant cities and transform them back again into pictures that can be flashed upon the screen.

Turning Photos into Radio Waves

Jenkins' method of transforming a photographic impression into a radio wave impression is based on the principle that the intensity of light falling on a material known as selenium determines the electrical conductivity of that material, or in other words, its resistance to electrical current. Light, after passing through a negative and a lens, strikes the overlapping portion of two rapidly rotating circular prisms. These prisms are ground in such a way that lights and shadows of the picture are sifted through them in a series of parallel lines very close together.

The emerging light, following these lines, is picked up by another lens in a selenium cell and is caused to fall upon the sensitive selenium that serves as the "eyes" for projecting vision great distances.

Light Control

Since the selenium cell lies in an electric circuit, light of a certain intensity falling upon it permits a definite amount of current to flow. The electric current varies with the intensity of the light. This varying current affects the wireless sending circuit in the same way as do the fluctuations of sound waves.

The receiving is accomplished by reversing the process of sending.

With Jenkins' present apparatus, four minutes are required to send a single picture. This is due to the fact that he rotates two of the prisms at only 400 revolutions a minute. By increasing this speed to 1600 revolutions, only one minute would be required; and when he is able finally to overcome the mechanical difficulties involved, he hopes to reach the average movie speed of 16 pictures a second.

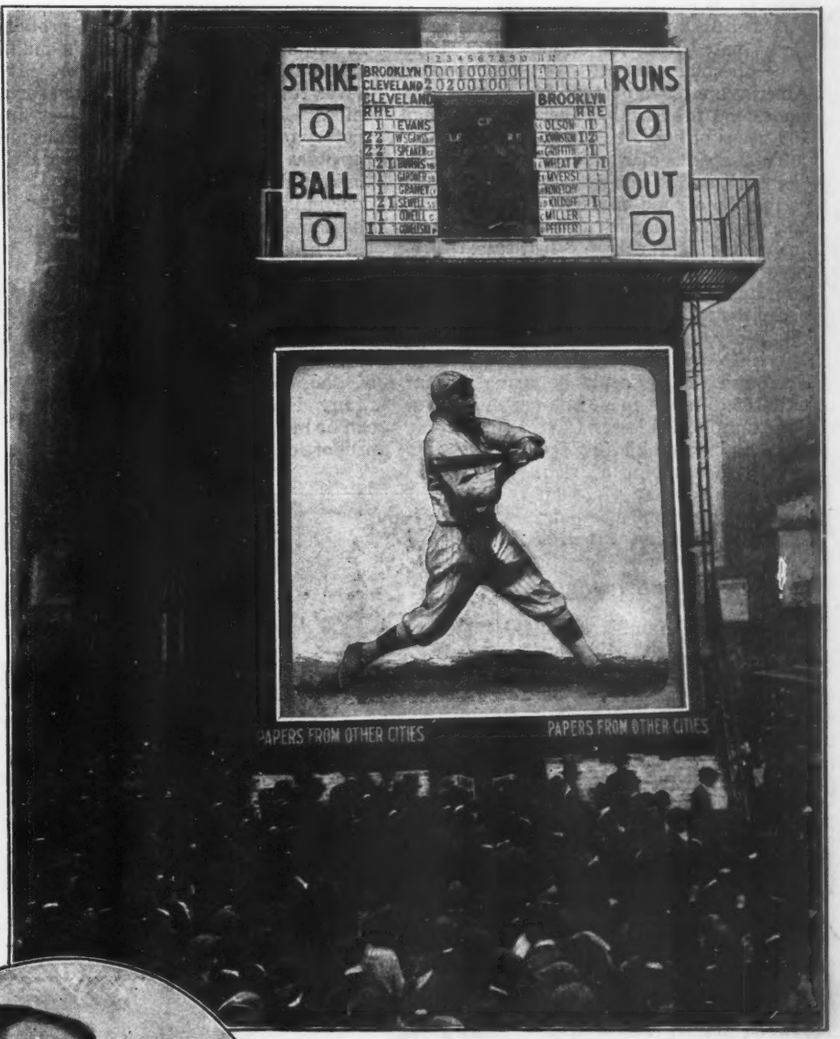
When this is accomplished, it will be necessary then to improve the machine further so that it will take photographs and transmit them without the use of negatives. The rays of light passing directly from the objects to the prisms will be sifted and impressed directly on the selenium cell.

Not only will it be possible to broadcast movies of news events in distant places, but also it will be possible for home radio sets to pick up broadcasted motion pictures just as music is now received.

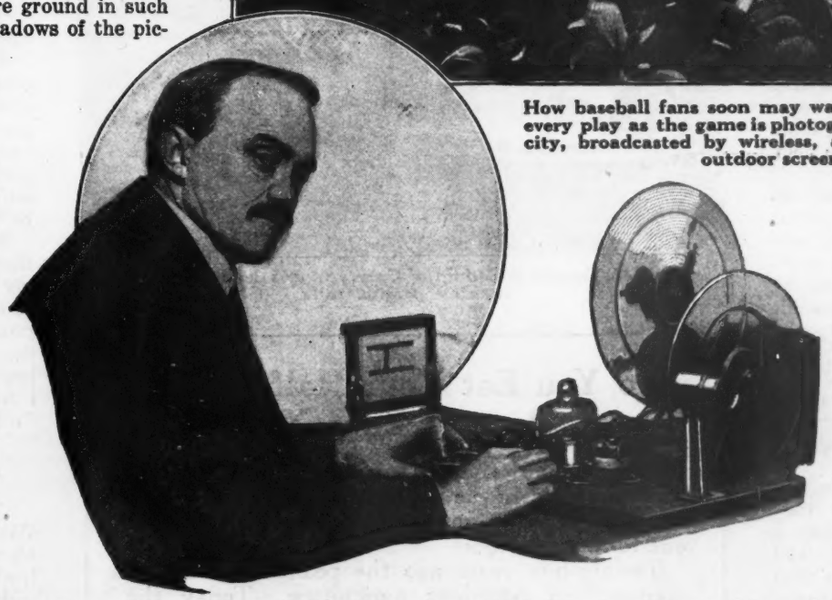
"But how can we see movies of a distant baseball game if they are thrown on an outdoor screen in broad daylight?" you ask.

One answer is found in the perfection of a daylight motion picture screen recently demonstrated successfully in New York City by Norman Furber. He says:

"The fact that the screen gives the best results even in bright daylight, provided the sun doesn't shine directly on its surface, is its most remarkable feature."



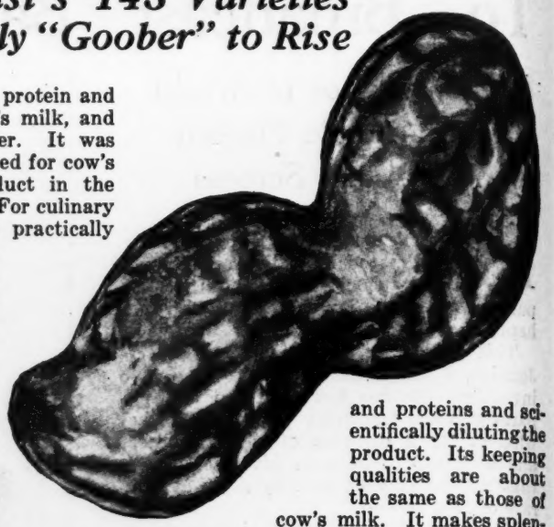
How baseball fans soon may watch every player in every play as the game is photographed in a distant city, broadcasted by wireless, and thrown on an outdoor screen



C. Francis Jenkins experimenting with his apparatus for sending movies by radio. Notice the rotating circular prisms that sift the lights and shadows of photographs in such a way that they fall on a sensitive selenium "eye" and are transformed into wireless waves

PEANUTS

How Scientist's 145 Varieties Helped Lowly "Goober" to Rise



AT LAST the lowly peanut has graduated from the circus tent. It has become, almost overnight, one of America's most important and most wholesome food products. It serves more than 100 needs of man.

This spectacular rise of the humble "goober" is due chiefly to the patient experiments of one man—George W. Carver, professor of agricultural science and husbandry at Tuskegee Institute. Professor Carver knows more about peanuts than any other man in the United States.

He took the friendless goober into his laboratory, cracked its shell, and probed deep into the secrets of its nutty meat. He found that it could be made into at least 145 different foods and useful articles. For example, Professor Carver found that one ordinary tumblerful of shelled peanuts will produce a pint of rich, creamy milk that you can drink in your coffee or pour over your morning cereal.

The Peanut's Progeny

Every one is familiar with peanut butter, but did you know that, besides 10 varieties of milk, peanuts can be made into:

Five kinds of breakfast foods, two grades of flour, ice cream in all flavors, cake, candy, salad oils, five kinds of punches, bisque, "Worcestershire" sauce, chilli sauce, oleomargarin, and cheese—not to mention four kinds of meal stock for cattle feeding?

Did you know, too, that peanuts can be made into many useful commercial articles, such as nine varieties of wood stains, leather dies in 19 shades, metal polishes, axle grease, toilet and laundry soaps, ink, tannic acid, and glycerin?

All these uses Carver developed—and he is still at work. Even now he is perfecting several peanut medicines, and he is making quinine from the red outside skins of the nut. Peanuts are one of our most wholesome, nourishing, healthful, appetizing foods, he says.

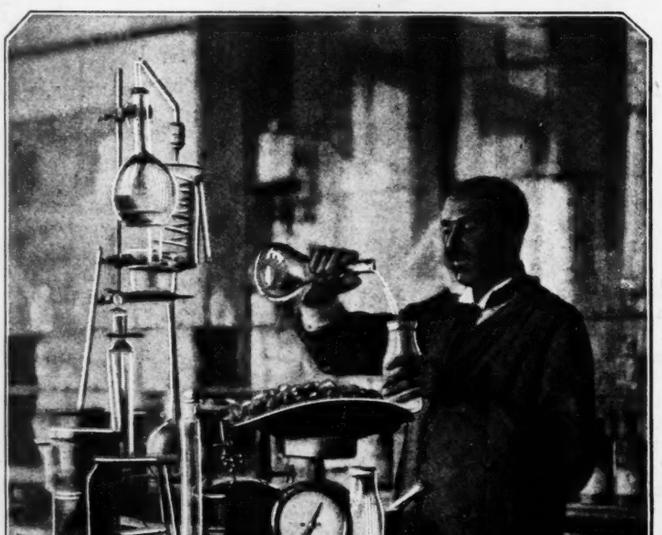
Steak vs. the Goober

"A pound of peanuts contains a little more of body building nutriment than a pound of sirloin steak, and nearly twice as much heat and energy producing nutriment," said Professor Carver. "Peanut oils are palatable and supply the body with heat, fat and energy. The peanut contains proteins in abundance, as well as the much prized legumin, lysin, myosin, and amino acids."

Concerning peanut milk, he explains:

"It is rich, creamy, and palatable, and it contains three times as much carbohydrates, three times as much protein and 12 times as much fat as cow's milk, and only one tenth as much water. It was never intended to be substituted for cow's milk. It is a distinct product in the dietary of the human family. For culinary purposes its possibilities are practically unlimited. The sweet and the sour milk both can be used in the same ways as cow's milk; the curds can be made into many fancy types of cheese and fillers for pastry.

"Peanut milk is a perfect emulsion of the oils, fats, proteins, carbohydrates and some of the ash of the peanuts. Many different kinds of milk can be made by controlling the proportions of carbohydrates and proteins and scientifically diluting the product. Its keeping qualities are about the same as those of cow's milk. It makes splendid bread, rich in flavor, and is excellent for creaming vegetables. Since it is a purely vegetable drink, it forms body building nourishment for invalids or children."



Prof. George Washington Carver in his laboratory, making peanut milk

Faced with Ruin

The event that started Carver on his efforts to help the peanut to fame was the disastrous invasion of the boll weevil into the cotton fields of Alabama. One day a wealthy woman farmer, owner of many acres, came to him and said:

"Mr. Carver, what are we farmers going to do for a money crop? The boll weevil is about to ruin us."

That started him thinking "How about the peanut?"

His laboratory experiments told him. They told him so clearly that their results have astonished the world, and have set men to planning great factories where the once neglected goober may be turned into foods.

And they have done more than that. They are returning a profitable money crop to thousands of acres of unprofitable farmland in the Southern states. They are beginning to save the South from the bondage of King Cotton.

Enriching the Soil

"The peanut crop is profitable because," Carver explains, "it has power to extract nitrogen from the air and deposit it in the soil, thus becoming a soil builder rather than a soil robber."

Today, this wizard of peanuts, George Washington Carver, rightfully may be called the Burbank of the South. By helping the ground pea on its way upward, he has added immeasurable wealth to the soil and has opened tremendous storehouses of new and nourishing foods for the world.

Do You Eat Your Half Bushel of Peanuts Each Year?

DID you know that last year every man, woman, and child in the United States consumed, on an average, more than half a bushel of peanuts in one form or another?

Twenty-five years ago the peanut was a "no account" in American agriculture. Today the annual production of peanuts in the United States—about 53,000,000 bushels—would fill a tank nearly two miles wide and 1¼ miles high.

The yearly production of peanut butter alone is more than 7,000,000 pounds, and of peanut oil more than 3,000,000 gallons. And these are only two of the 145 useful products developed from the goober, largely through the experiments of Professor Carver. Important results of his work are described in the accompanying article.

Iron Finger Discovers Sunken Treasure

How Falling Mass of Iron Located Rich Copper Cargo Buried in Mud "Somewhere in New York Bay"

AN ELECTRICAL needle that searches the sea's bottom for sunken metal has been responsible for the salvaging of a million pounds of copper, valued at $150,000, from the bottom of New York Harbor. Divers predict that the ingenious device, which is the invention of R. E. Chapman, a naval engineer, will reclaim millions of dollars in lost cargoes.

In January, 1920, the navy barge "Anode," loaded with copper bars, was rammed by the army transport "Buford." The barge tipped over, dropped its treasure into the bay and then floated away. There were few witnesses of the collision because of a dense fog, and therefore no one could give exact information of the location.

Harbor Is Charted

In undertaking to raise the metal bars, a New York wrecking company first learned that they lay somewhere in the main channel between Governor's and Bedloe's islands. This vast tract was then charted in seven-foot squares. Finally, a specially designed iron weight was dropped into the river bed at each corner of the squares thus formed. The method of making these soundings was as follows:

A car barge carrying a traveling derrick was pulled along the lines of the charted squares by hauling in on the forward anchor lines. Whenever the barge reached a corner, the ton weight, eight feet long and pointed at the nose, was dropped over the side, penetrating the mud bottom to a depth of 10 feet. To the weight was attached a cable from the derrick above.

The Ammeter Reports Success

An electric current was then run through the iron mass and through electric wires paralleling the cable to a special ammeter on the barge. When mud or iron was struck by the pointed weight, the ammeter needle deflected in one direction; but it was known that if copper was struck, the ammeter would record it by an opposite deflection. After innumerable trials, the iron crashed down into the mud in which the copper bars were embedded, the needle showed that the search had been rewarded, and the work of hauling up the metal was begun.

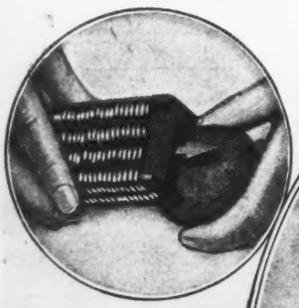
An orange-peel bucket was then substituted for the iron weight. This bucket was lowered into the mud and when it was hauled back to the deck, it was found to contain several bars, which were identified, by certain numbers that each bore, as part of the "Anode's" lost treasure.

As the salvaging progresses, the ingots, after they are hoisted in the bucket, are washed off at the depot of the wrecking company. From there they are shipped by motor truck to the government warehouse.

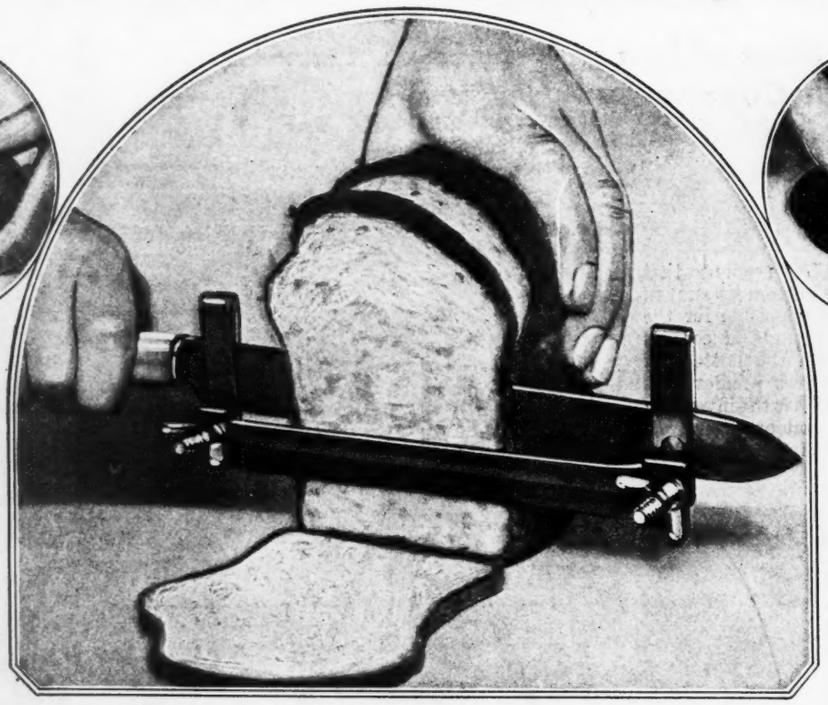
Naval officials expect that all the copper will be recovered.

Crashing through 10 feet of mud, the iron weight located sunken copper bars as shown at the right. Above: Washing mud from the copper hoisted in derrick bucket

Put the Kitchen on an Efficiency Basis



The potato scraper pictured above takes off the skin with the least possible waste. It is made of sharp metal strips stretched across a wooden frame



Slices of bread can be cut exactly the same thickness by the use of the gage shown above, which fits any knife. The thickness of the slices can be adjusted by the wing nuts at the ends

This little pot and pan cleaner protects the knuckles of the operator. The handle is at the center of a triangular scraper

The above utility kitchen chair, with or without a back, combines with it a ladder and a shoe-shining outfit

Draining boiling water from cooked vegetables has caused many a scalded hand, but by the use of this perforated boiler, the contents automatically drain themselves when lifted from the saucepan to the sink

Where electricity is not installed, this small and light weight vacuum sweeper is pumped by hand to create a suction

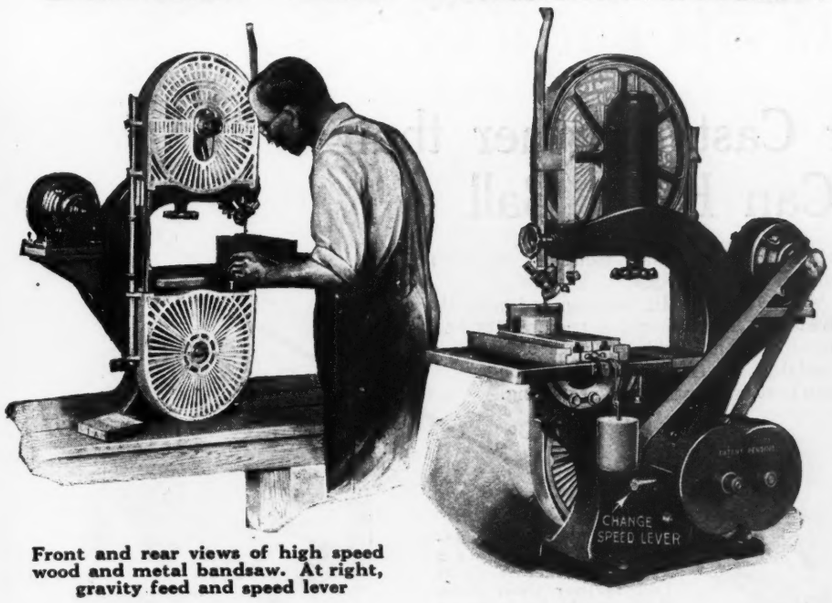
Why wasn't it thought of before? Here's a nail polisher that boasts an easily removable strip of chamois, which means an easily replaceable one. The "spares" come in sealed waxed paper packages

Made of flat three-eighth-inch iron in open scroll shape, the above device is said to assure the even and quick frying of the cheaper cuts of meat. The fryer also prevents the nutritious juices from escaping

This electric toaster will toast both sides of a slice of bread at once, while frying eggs in the small pan above it

It cooks while it heats. This neat looking heater will fry, boil, or toast food, thus saving space in cramped quarters

Bandsaw Cuts Wood or Metal



Front and rear views of high speed wood and metal bandsaw. At right, gravity feed and speed lever

A PORTABLE bandsaw, designed to cut either wood or metal, is finding ready application in small plant repair shops, where its twofold service eliminates the necessity for separate machines.

The machine has a two-speed attachment—the slow speed for metal work; the high speed for wood. By means of a special saw guide, the usual wood and metal blades may be quickly inserted when changing from one type of work to the other. Special combination spring temper blades are provided, however, and these will serve for both wood and metal work at high speed.

A gravity feed vise attachment that draws the work against the saw teeth, permits the cutting of bar stock, rounds, flats, and shapes up to three inches in thickness.

For materials that are to be cut at an angle, the work is clamped to the table, which can be tilted at any desired angle up to 45 degrees.

Here's a Way to Pull Weeds without Backache

TWO prongs attached to a long hardwood handle and connected by a crosspiece form the weed puller recently invented to take the kinks out of the gardener's back.

The sharp prongs are slipped under the roots of a weed and the handle is pulled upward. The roots are caught between the prongs and the crosspiece prevents them from slipping out as they are forced from the ground.

How the weed roots are caught betwen prongs and pulled

EACH patient applying for treatment for rabies at the Pasteur Institute at Breslau University, Germany, must supply a whole, live rabbit for innoculation. No dead ones allowed. Two rabbits are preferred if patient can afford it.

Tree Branches Crafted to Form Living Splice

TO PROTECT fruit trees from severe storms that often split branches and even completely uproot trees, investigators of the Ohio Agricultural College have succeeded in intertwining branches to form living splices and so support each other.

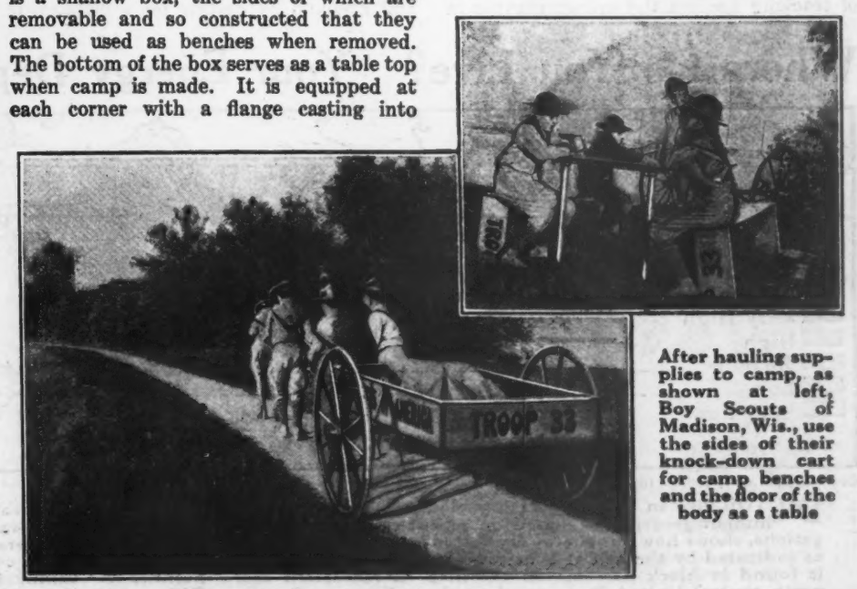
This method of grafting has been found to be exceedingly satisfactory, and it is claimed that branches actually coalesce and unite, causing them to appear as one limb with two points of origin.

Knock-Down Cart Is Boy Scouts' Table

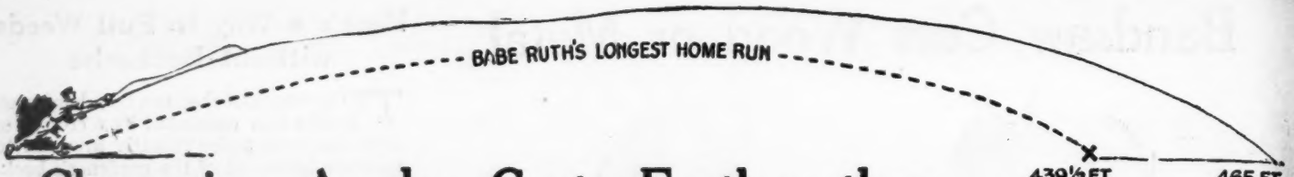
BOY Scouts of Madison, Wis., have built an ingenious collapsible "trek cart" designed so that it can be used not only for carrying equipment on the hike, but for "furnishings" about the camp.

The body of the light, two-wheeled cart is a shallow box, the sides of which are removable and so constructed that they can be used as benches when removed. The bottom of the box serves as a table top when camp is made. It is equipped at each corner with a flange casting into which iron pipes may be screwed to form table legs.

When the scouts reach camp, the axle is unbolted from the box, the wheels and axle form a convenient carrier for firewood, while the body provides table and benches.



After hauling supplies to camp, as shown at left, Boy Scouts of Madison, Wis., use the sides of their knock-down cart for camp benches and the floor of the body as a table



Champion Angler Casts Farther than Babe Ruth Can Hit a Ball

DID you ever try the sport of fishing on dry land, several miles away from any water or any fish?

If not, you've missed a sport enthusiasts say is the greatest thriller of the day and that medical authorities say is an ideal outdoor exercise. In fact, the game of fishing without fish bids fair to rival football, baseball, and basketball in popularity, largely because of its suitability to the needs of business men, the scientifically correct principles of exercise it involves, and the competitive thrill it encourages.

Twenty years ago America barely knew this sport, known as dry surf casting. Today it has thousands of devotees. Almost any afternoon or holiday in the year, you may see, in parks and fields around New York City, groups of men with their fishing rods diligently practising for hours the art of casting. Although the sport was originally devised as a method of teaching novices the proper manner in which to cast in surf fishing, these men seldom see the ocean.

An ordinary split bamboo rod with its usual reel attachments is used. Attached to the reel and rod is hundreds of feet of special 12 linen line, somewhat stronger than that usually used in surf fishing. On the end of the line is a four-ounce pear-shaped lead.

Casting a four-ounce lead sinker nearly 30 feet farther than Babe Ruth could hit a baseball, Harold G. Lentz, world champion "dry surf" fisherman, amazed 30,000 fans, as well as the home-run king himself, at a recent exhibition in the Polo Grounds, New York City

Babe Ruth congratulating his conqueror

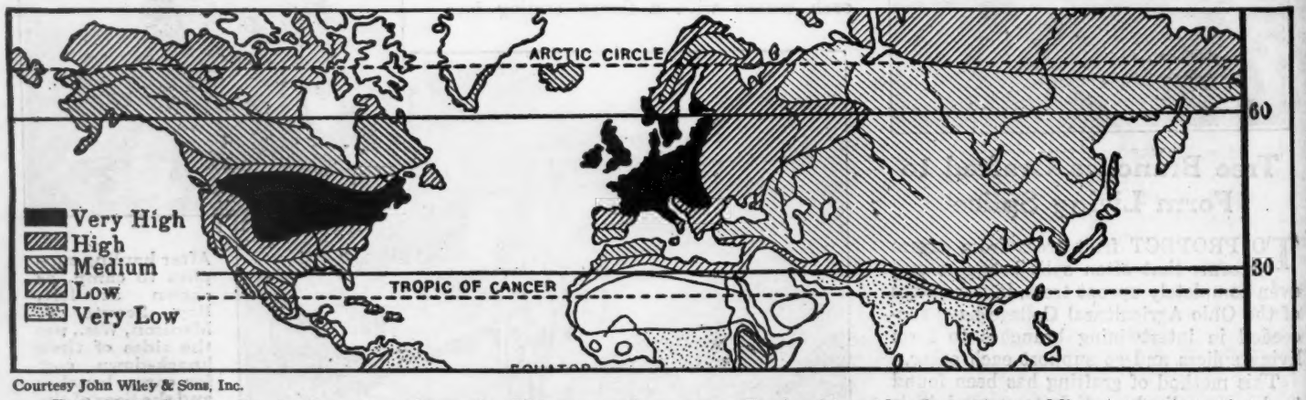
With reel wound so that the lead has a play of only a few inches over the end of the rod, the caster manipulates the rod so that it extends behind him, over one shoulder, as far as possible. Bringing the rod up and forward with a terrific speed, using his forearm as a lever, he suddenly arrests its motion with a jerk. The attached lead carrying with it the line that unwinds from the reel, speeds through the air with the force of a shot from a gun. The object, of course, is to attain great distance. The distance of a cast—like that of the shot put or discus throw—is measured to the point where the lead first strikes the ground.

Tremendous distance casts are accomplished in this way. In 1910 W. J. Moran startled fishermen both of this country and England by casting for a distance of 314 feet. Year by year the record was increased until in 1920 Harold G. Lentz, the present champion, attained a distance of 465 feet. He also set another world's record by casting three times for an average of 434 feet 11 inches.

This feat aroused so much comment that an argument arose as to whether Lentz could cast a four ounce lead farther than Babe Ruth could hit a baseball. In an exhibition in New York Lentz outclassed Ruth in distance, surprising some 30,000 fans at the Polo Grounds and the home-run hitter himself.

The sport is now controlled by a national association known as the Association of Surf Angling Clubs and a $2000 perpetual trophy is given by the Ocean City Surf Casting Club for the record tournament cast each year. Many women are becoming interested in the sport and some of them have attained records as high as from 235 to 250 feet.

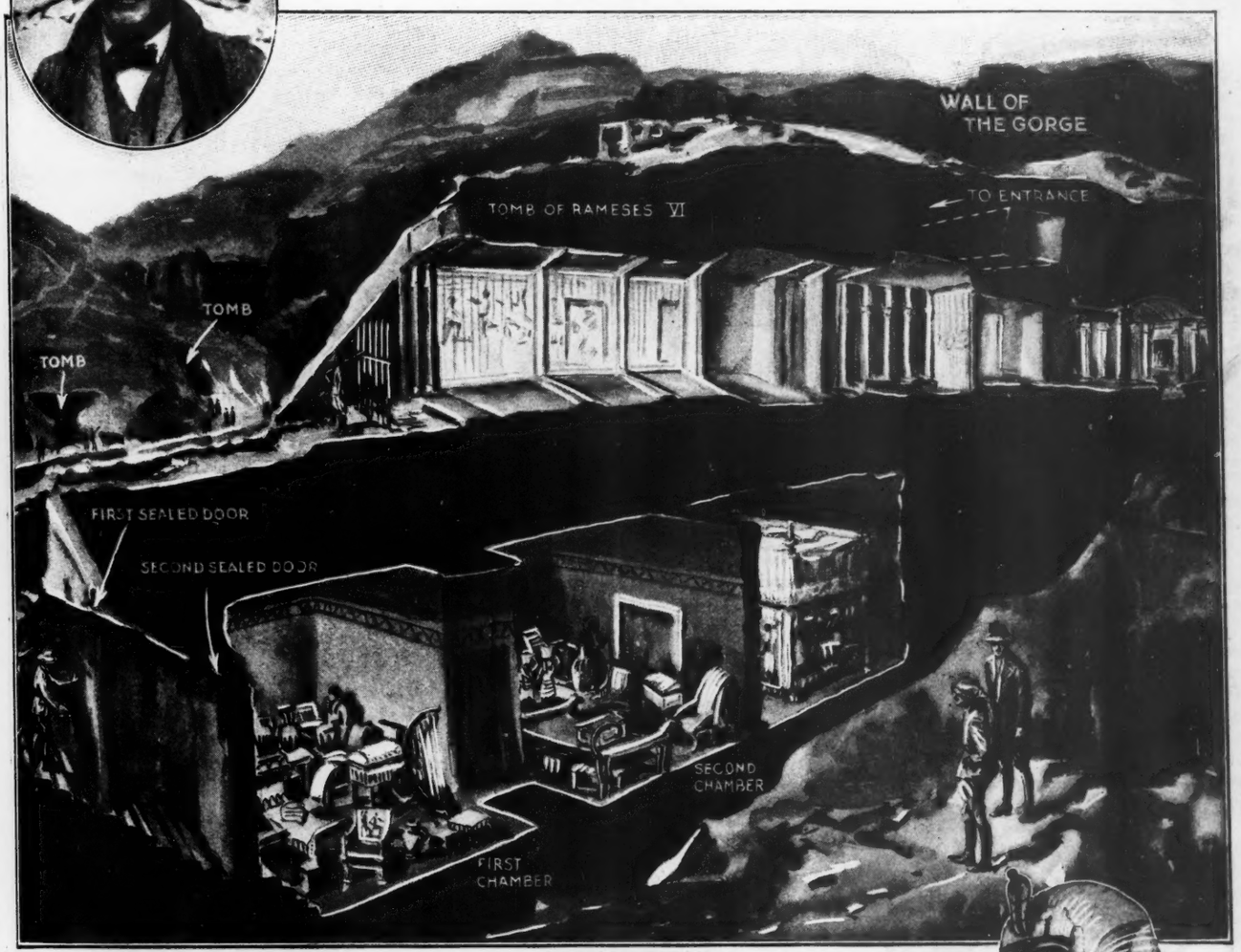
Where Do You Live? Your Energy Depends on the Climate



Courtesy John Wiley & Sons, Inc.

DO YOU live in an invigorating climate? This map of "human geography," based on recent scientific investigations, shows how our energy is affected by various climates, as indicated by the key at left. The highest human energy is found in black portions on the map—northeastern and north central United States, and northern Europe. Southeastern England is said to have the world's most invigorating climate—frequent variations in temperature; cool but not cold winters; temperate summers and relatively high humidity. These are the conclusions of Elsworth Huntington and Sumner W. Cushing, in their new book, "Principles of Human Geography" (John W. Wiley & Sons, Inc.)

"Lost Pharaoh" Defies Scientists to Bring His Mummy to Light



How King Tutankhamen's tomb was bored into the hillside beneath the tomb of Rameses VI in the Valley of the Kings. Note the burial chamber beyond two outer treasure chambers. Howard Carter, American Egyptologist, who made the discovery, is shown in inset

HOW will scientists get at King Tutankhamen's mummy?

What further undreamed-of splendors lie hidden within the inner burial chamber of the great Pharaoh who ruled Egypt more than 3000 years ago—500 years before Solomon?

The world, fired with curiosity and imagination by the richest treasure find in history, must wait in suspense for an answer. For, the last of all the powerful Pharaohs to give up his wealth from the ancient royal burial ground in the famous Valley of the Kings, now defies the world to bring him to light!

For 15 years Howard Carter, noted American Egyptologist, backed by the millions of the Earl of Carnarvon, dug through the Valley of Kings, searching for King Tutankhamen's tomb. At last they found it, buried by rubbish and sand, at the foot of a stairway leading down beneath the tomb of Rameses VI. Two outer chambers gave up amazing treasures of the dim past. Then, piercing a sealed door at the far end of the second chamber and passing between two statues of the ancient king that had stood as sentries for 30 centuries, they came to the supposed royal burial vault.

Standing at the threshold of the supreme discovery, peering through a hole in the wall, they found the way to the king barred!

King Tutankhamen is barricaded. Like a nut in a hard shell, his embalmed mummy is believed to lie hidden at the center of a series of screened and canopied shrines. And it will take all the ingenuity of modern science to reach him.

Between the wall of the burial chamber and the wooden screen of the outermost shrine, the passageway is only 18 inches wide. At one side and somewhat lower than the main burial chamber is a small annex packed with added treasure and reached by a small opening.

To reach the king's mummy or to bring out the new treasures, the exploring scientists must reverse the order of the builders. First the shell of each successive tabernacle must be removed before the next one within can be opened; and to do this the outer wall of the burial chamber must be demolished. But the interior of this wall is covered with paintings and inscriptions, all of which must be copied and interpreted by scientists.

Yet while King Tutankhamen's 30-century sleep remains undisturbed, the discoverers have been repaid far beyond their dreams.

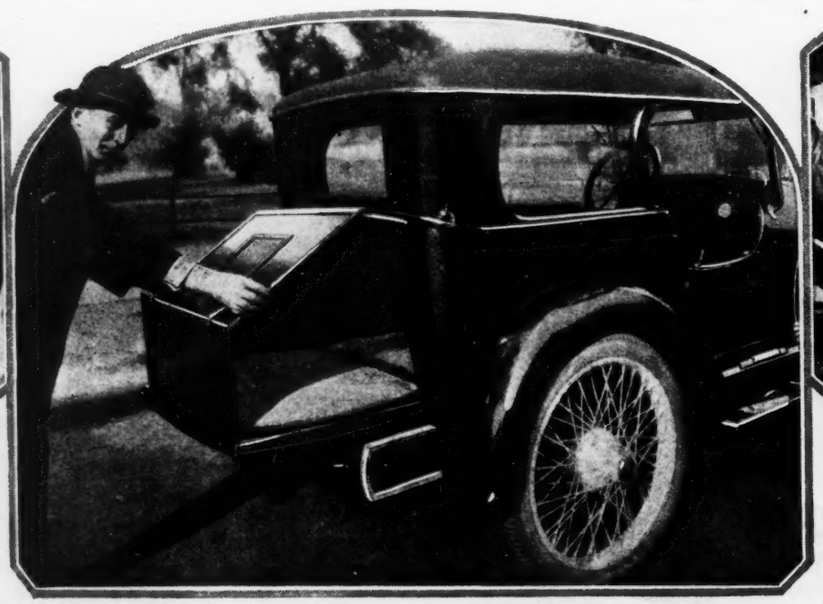
© London *Times*—*New York Times*, by arrangement with the Earl of Carnarvon

A life-size statue of the "lost Pharaoh," guarding the doorway of the burial chamber

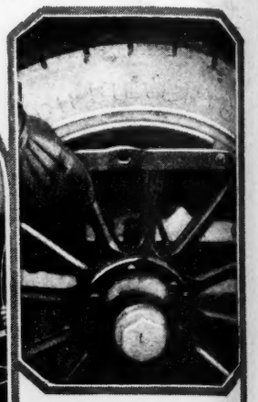
Conveniences for Spring Touring

A Comfortable Auto Bed for Two—Other Novel Accessories of the Month

A threadless dust cap for automobile tire valves is attached simply by pressing on it. It is held in place by a strong spring within the cap

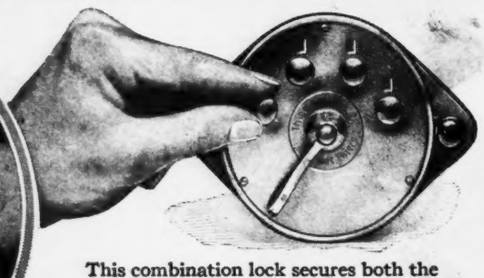


By opening a flap in the rear and lowering movable tonneau cushions, this car is speedily transformed into a sleeper for two persons

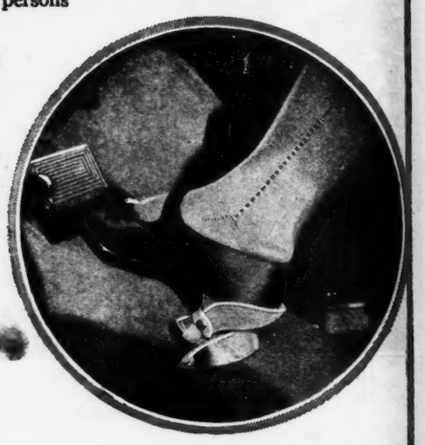


The end of this rim wrench is a tool for removing clincher tires from wheels. The wrench section has two spanner holes that fit most rim nuts

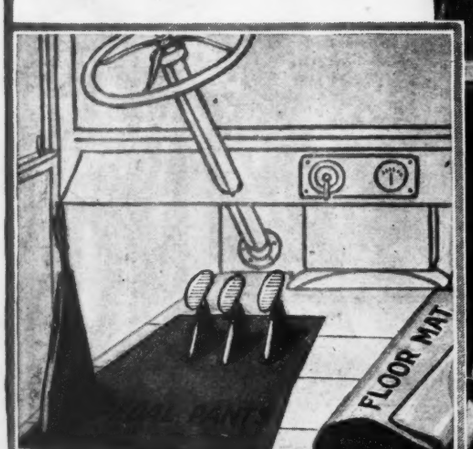
This spotlight, if placed so that it throws light higher than is lawful, automatically lowers itself by the action of a previously set electric plunger switch shown on the bracket



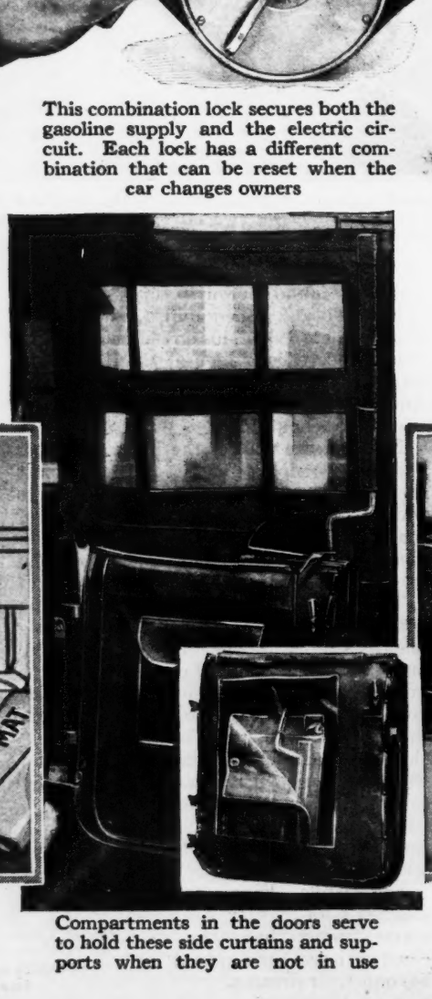
This combination lock secures both the gasoline supply and the electric circuit. Each lock has a different combination that can be reset when the car changes owners



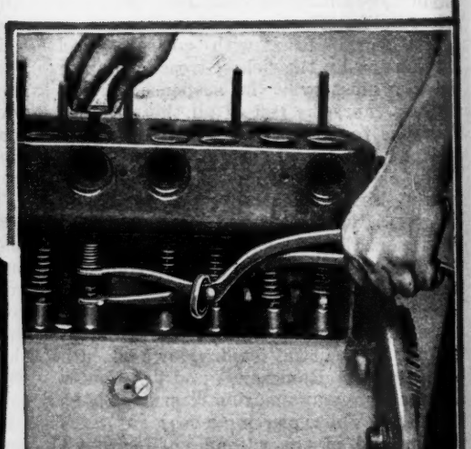
A leather pad, strapped around the heel, protects the shoe against wear while operating the accelerator. Since it is fastened to the shoe, it allows free movement of the ankle



A small pad that fits snugly about the pedals and brake arms of Ford cars, under the floor mat, keeps out engine heat, dust and dirt in the summer and cold drafts in the winter



Compartments in the doors serve to hold these side curtains and supports when they are not in use



The ring on this valve spring lifter, when drawn back, locks the tool after the spring has been compressed and leaves the mechanic's hands free to remove the valve stem

How to Cut Your Car Costs

Auto Expert Tells Fifteen Every-Day Ways to Keep Expenses and Depreciation Down to the Ideal Low Mark

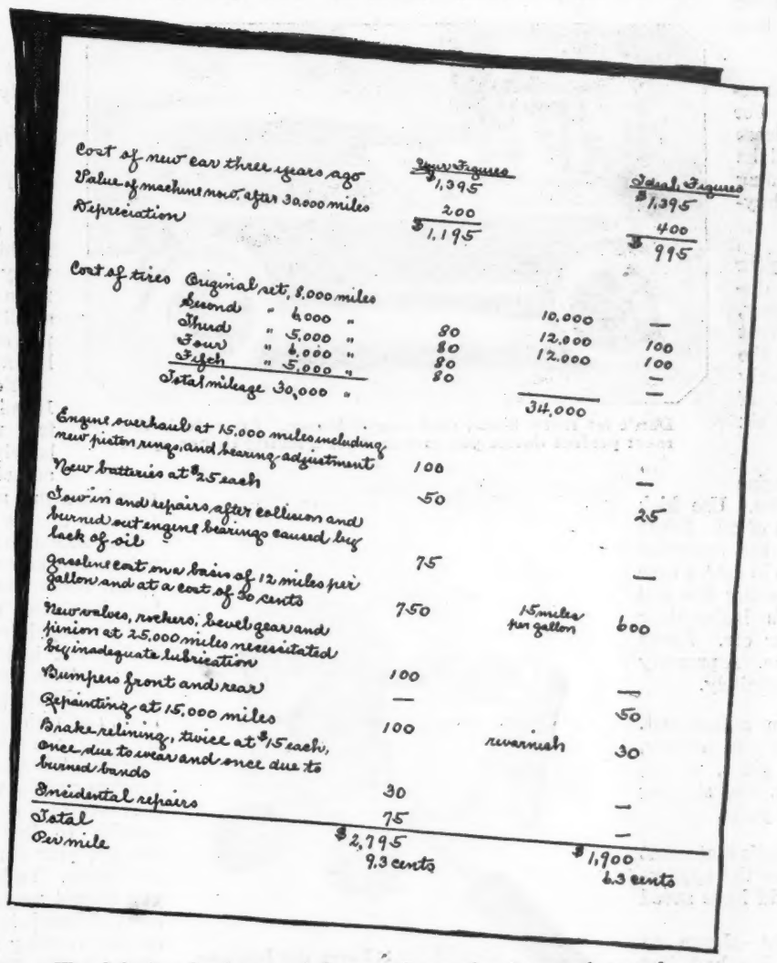
By H. F. Blanchard

"I'VE just bought a new car," the visitor across my desk announced, "and I've come to ask you how to keep my expenses down to the bone. In three years my last car cost me more than $2700—upward of nine cents a mile. That's more than I can afford; but what can I do? I've heard men say they are able to keep their expenses down to five or six cents a mile. How do they do it?"

Anybody Can Save

His problem lies so close to the pocketbook of every automobile owner that I am going to repeat his questions and my answers, explaining important ways of saving car costs that anybody can practise successfully.

"Here is a little résumé of my expenses," said my visitor, showing me an itemized list of his costs for three years. The total was $2795, or 9.3 cents a mile. That set me figuring; then opposite the items on his list I wrote "par" figures—that is, the ideal figures representing what his costs should have been if he had taken the proper care of his automobile.



The left hand column of figures shows the items of cost for one owner's car for three years. The right hand column shows what these costs should have been if he had properly cared for his car

My total was $1900, or 6.3 cents a mile! In other words, he had wasted more than $800 in three years.

"That's more like it!" he exclaimed, as he studied the "Ideal Figures." "Tell me how to do it!"

So I explained each of the 15 points that, if observed carefully, will automatically cut the expenses of any car to par. Here they are:

1. INSURE your car against fire and theft, and equip it with a fire extinguisher and a good lock. If you lose your car by fire or theft and it is not insured, you are adding to your expenses an amount equal to the value of your car.

2. PUT on spring bumpers front and rear. Bumpers are real insurance against collisions, and they protect the passengers. A bumper would have prevented that $75 collision item on your expense list. If a car is equipped with a good bumper, you can run into a tree at 15 miles an hour and both passengers and car will come off unscathed.

The Typical Auto Owner

FROM figures based on many thousands of transactions, recently compiled by a great banking institution, the average American purchaser of an automobile may be described as follows:

He is a married man 33 years old.

He has a bank account and carries life insurance.

He buys a $1400 car and pays $700 down.

He pays the balance at the rate of $100 monthly.

His monthly income is $350.

He owns real estate in which his equity is $5000.

He has personal property worth about $2000.

This is not his first car.

3. DRIVE carefully and considerately. This advice means that you shouldn't run a new car much faster than 20 miles an hour for the first 500 miles. The same holds true after the engine has been overhauled. Five thousand miles can be taken out of the life of the engine by mishandling during the first 500 miles. Use your clutch and brakes gently and shift gears skilfully. Observe the rules of the road. Take no chances. BE TWICE AS CAREFUL AS YOU THINK YOU OUGHT TO BE. Thus accidents and premature repair bills—both large items of expense—may be avoided.

4. TO preserve the finish of your car, wash it frequently in clear, cold water. Never use hot water or soap on the body. Never keep the car in a barn; do not dust it and never allow mud to stand on it. Revarnish it before the varnish skin wears threadbare. Appearance is an important item in car depreciation.

5. NEVER put your top down. Modern top material soon loses its newness and cracks and tears when the top is put down.

6. LEARN to know your car and how to make all minor repairs. For other repairs find a good repairman and stick to him. It pays to have a man who knows the history of your car and feels a certain responsibility for its performance.

7. KEEP all nuts, bolts, and screws tight. Inspect the car periodically, especially electrical connections.

8. STEER clear of bargains unless they are real. Avoid second rate spark plugs, "gyp" tires, cheap lubricating oil and catchpenny money saving devices.

9. BUY good tires and keep them inflated. Always have a spare tire and tube with you. To be without a spare is to run risk of ruining a punctured tire and tube.

10. PAY cash for supplies, repairs, and gas and be sure to get your money's worth. Credit

fosters errors and dishonesty in the average repair garage.

11. AVOID extravagant expenses. Don't be like the man who incurred a $10 taxi bill and a $15 tow bill because his old battery finally laid down on him about three o'clock one cold morning. Don't spend $10 a year replacing lost tools. Form the habit of taking a last look for stray tools.

12. DON'T postpone necessary repairs. For example, don't run with a loose bearing, or to this bill will be added the cost of straightening the crankshaft or perhaps buying a new one.

13. DON'T neglect your battery. Give it distilled water at least once a week, keep it charged, and prevent overcharging by turning on the lights. A good battery properly cared for will last for years. If neglected, it will last only six or eight months.

14. CHANGE the engine oil every 500 miles. Use high grade oil and the right kind of oil. Select a grade recommended by the manufacturer of your car and buy it in sealed cans to be sure that you are getting the real stuff. Follow the maker's instructions carefully in lubricating your car. Never put kerosene into your engine. A properly lubricated car will wear indefinitely.

15. KEEP your car in adjustment. This means the carbureter, breaker mechanism, spark plugs, valves, clutch, bearings, bevel gear, and steering gear, as well as many minor parts.

Returning now to my friend's statement of expenses, let's see just how the application of these 15 points would have saved him money.

The first item in his list—shown on page 75—is depreciation. He had just sold his car for $200. It cost $1395. Therefore the depreciation during the three years he owned it was $1195. Remember that depreciation always must be included in car expenses; also, that depreciation is the difference between the cost of the car and the price you can get for it. The par figure in the second column shows that the car should have been worth $400 when he sold it, or twice what he got for it.

"But why was my car worth only $200 when I sold it?" my visitor inquired.

"Because of numerous shortcomings that you have indicated," I told him. "It needed painting badly, the engine was noisy and lacked power, the tires were worn out, the battery was in bad condition, the upholstery was scuffed, and the top leaked.

"You used five sets of tires, including the original equipment. The first set went 8000 miles, and the others ran from 5000 to 6000 miles. You bought a variety of makes and a great many so-called bargains. In addition you failed to inflate your tires, you skidded corners, drove in wet car tracks, and frequently locked the rear wheels. Your tires cost you on the average of $20 each, but your total bill was $320. It might have been $200 if you had bought first class tires and cared for them properly.

"At 15,000 miles you required new piston rings, adjustment of the engine bearings, and new valve parts. Why? Because you bought any old oil and changed it hardly once in 5000 miles. You frequently forgot to push the choke in, thus flooding the cylinder walls with gasoline. Also you let the oil run low on two or three occasions, and twice you let the water boil away. All these things caused excessive wear of pistons, rings, and cylinders. Neglect of lubrication caused the bearings to wear rapidly.

"If you had changed the engine oil every 500 miles, or every 1000 miles at the most, if you had never allowed the oil to get low or the water to boil away, the chances are that the original rings would still be giving good service.

"One of the new batteries that you bought was ruined by fast driving and lack of water. That was an expense that might easily have been avoided.

Three Important "Don'ts" for Car Owners

Don't let nuts, bolts, and screws loosen. An auto is the most perfect device yet invented for shaking things apart

Never use hot water, soap, or duster on the polished body of your car. Wash it in clear cold water

Don't fail to insure your car as protection against thieves. Theft and fire are the most expensive of all expenses unless you carry insurance

Bumpers Save Damage

"You had a collision that cost $75. You were lucky that it did not cost $500. Probably it might have been avoided entirely by the exercise of a little more care, but surely even this small damage might have been prevented if the front of your car had a spring bumper.

"You should have averaged 15 miles to the gallon, but the fact that you got only 12 is largely due to careless carbureter adjustment, general car condition below par, and your failure to see that you got all the gasoline you paid for.

"At 25,000 miles you had to buy new valves and new valve rockers. The latter would never have worn out if they had been lubricated regularly.

"You repainted the car at 15,000 miles and yet it looked threadbare when you sold it. This was due to a combination of things. First, you kept your car in a barn, and residual ammonia fumes remaining about the structure ate off some of the varnish. Then you used body polish. The average polish, while it improves the appearance of a car temporarily, causes the varnish to lose its luster prematurely. Finally, your garageman used strong soap and water. To keep your car looking well you should wash the body in cold water only, although it is permissible to use soap on the running gear. Soak the dirt off with a gentle stream from a hose, sponge the body gently, and dry with a chamois. Have separate sponge and chamois for the running gear. If you have a convenient place to wash your car and good equipment, including rubber boots and apron, you'll be surprised how quickly it can be done.

Why Brakes Wear Out

"You had to have your brakes relined twice—once because of excessive use and abuse (and this explains some of your tire trouble), and once because the brakes were adjusted too tightly and you burned the linings.

"By a little forethought you can avoid a host of unnecessary expenses, such as the loss of tools, lap robe, spare tires, loss of the use of your car, needless repair bills, overcharges, accidents, fines for speeding, etc.—all expenses that could be avoided.

"There is just one item in which you need never economize. It is oil. High grade oil, and plenty of it, is the cheapest thing you can buy.

"Finally, watch the fifteen points and, by unceasing vigilance, keep your rate of actual depreciation as close to the ideal line as possible.

Champions Show How to Change Tires Quickly

HOW long does it take you to change a tire?

Do you dread the job more than any other job about your car? Do you bang the rim with a hammer and skin your knuckles trying to get the stubborn tire off?

If so, you may be encouraged to know that all the drudgery can be eliminated once you have the right kind of tools and learn a couple of simple tricks. So says "Lightning Jim" Kennedy, of Seattle, Wash., who holds the world's stunt record for changing a tire in 22 seconds.

"The changing means a lot more than attaching an inflated spare, already mounted on a rim, to your wheel," he says. "It means removing the tire from the rim, taking the tube and flap out of the tire, putting in a new tube, and replacing the tire again."

Experience and the Right Tools

Fred A. Schmidt, Jr., of Milwaukee, Wis., who holds a somewhat different sort of record, is another champion who says that tire changing can be made simple and easy. In a recent contest he performed the operation of jacking up the car, deflating the tire, removing tire and tube, inflating the tire with a hand pump and pushing the car off the jack—all in three minutes and 31 seconds.

Both champions say that the secrets of their speed are two:

The right tools.

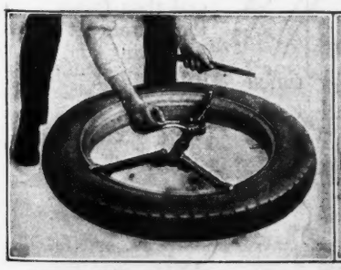
Experience.

Kennedy, working on a split rim—a rim that is not continuous, but cut through on one side—uses the ingenious tool shown at the bottom of the page to break the rim and release the tire. The tool resembles an automobile jack with a crank and a bevel gear drive to a screw head. Some sort of a tool of this type is almost essential for quick work in breaking a split rim, he says. He also uses a tire iron, one end of which resembles a screwdriver with a slight bend in it.

Loosen Tire Evenly All Around

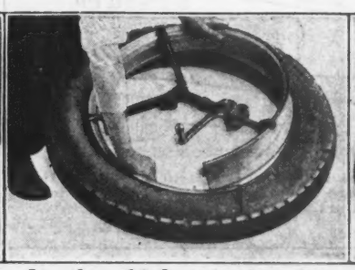
In hanging up the long-distance record, Champion Schmidt worked on a Ford 30 by 3½ inch clincher tire, mounted on a solid rim—that is, a rim that is not collapsible. In this case the tire must be pried off the rim with a hand tool. The best way to do this, he says, is to push the edge of the tire casing from under the lip of the rim and pry the edge free, repeating the operation all around the tire until the outer bead is loosened. The most common mistake in removing a tire is to force the tire off at one place, opposite the valve stem, causing the rest of the tire to bind.

Fred A. Schmidt of Milwaukee, Wis., setting a Ford tire changing record of three minutes and 31 seconds, beginning by jacking up the car and ending with the tire fully inflated by hand



How "Lightning Joe" Kennedy attaches his tire-changing jack. As he turns the handle, the three brace arms split the rim

Once the rim is broken, he pries the ends apart with a convenient hand tool, one end of which is shaped like a chisel



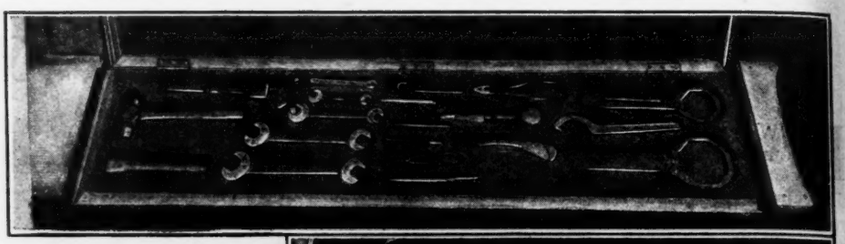
In the third operation he turns the jack handle until the rim is fully contracted, then quickly lifts the rim from the tire

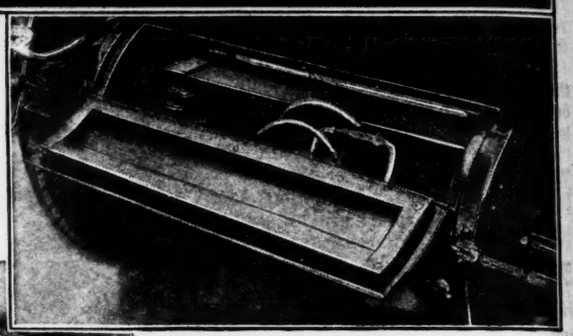
Slipping the rim back in place with the aid of the hand tool, he gives the handle a few turns and the job is done

Handy Toolboxes You Can Make for Your Car

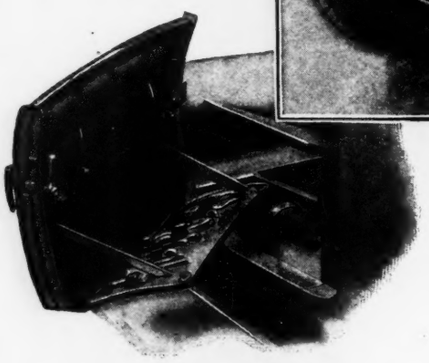
ANY motorist can build a tool compartment for his car that will meet his needs better than the ordinary underseat toolbox. The usual box is objectionable because the tools are not readily accessible and the space is too limited for carrying an adequate assortment, but an ample kit can be carried conveniently in a tool compartment built into the left front door pocket, or placed in a tray box countersunk in the runningboard, or housed in a compartment built over the gasoline tank.

In many ways the toolbox in the runningboard is attractive. It utilizes space that is going to waste and yet offers the maximum convenience.





The tool tray shown above lies directly beneath the runningboard and covers a toolbox. The compartment at the right is built over the gas tank, and that below is in the right front door



Toolbox Built under Runningboard

The runningboard is first removed and carefully sawed through at the runningboard irons, as shown, so that it forms a hinged cover to the toolbox. Under this cover is a tool tray large enough to accommodate the more ordinary tools. This tray lifts out and underneath is a tool compartment 5 or 6 in. deep. It carries the jack, tire pump, chains, and various odds and ends.

In order to support the section of runningboard at each end, a flat metal plate should be placed on the runningboard iron. The plates are bolted to the runningboard iron. Door hinges will serve for the hinges.

The exact dimensions of the box depend on the width of the runningboard and the distance between the runningboard irons. The box proper is best constructed of 3- or 5-ply wood approximately ⅜ in. thick, but if this is not easily obtainable, oak or pine may be used. Use plenty of screws because of the car's vibration. The box is attached by cleats to the runningboard.

Details of runningboard box

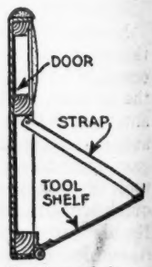
The obvious way to make the tray is to take a soft wood board of the right size and carve out a space for each tool; but an easier way is to make the tray in two pieces and cut the forms of the various tools right through one ½-in. piece with chisel or scroll saw. This piece is glued to a ¼-in. bottom board. When the tray is finished, felt may be glued to it to prevent the tools' rattling.

The left front door may be utilized by cutting away the upholstery between the middle and lower cross braces on the door, and fitting in a leather tray, hinged at the bottom so that the tray will close the compartment. The tray is made of two thicknesses of leather, with 3/16-in. wire reinforcement around the edge. Stitching the two pieces together with the wire in place can be done in a few minutes by any shoemaker. He can also supply you, as a rule, with the necessary leather.

The tools most frequently used are mounted on the tray, as shown, and the others are rolled up in a tool bag and kept within the compartment.

In making a tool compartment over the gasoline tank, the first step is to lay a floor about ⅜ in. thick on the gasoline tank. Wooden ends of suitable shape are then made up and finally a curved sheet metal cover, hinged at the bottom, is attached. This cover is held to shape by wooden cleats, as shown. The cover may be attached to its frame by round head screws or, if a more perfect job is desired, the surface of the metal may be countersunk and, after the flat screws are put in place, the countersunk spots filled with solder and scraped to a smooth surface.

If a kit of properly selected tools of good quality is kept handy in any one of these three ways, the motorist will find that roadside repairs are not nearly so irksome as they usually are. The right tool will come to hand instantly, and having the right tool is half the battle.



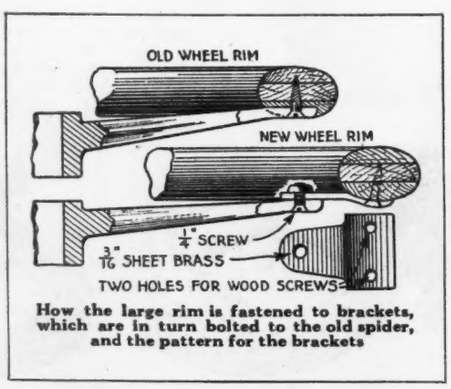
Section of door with toolcase

Attaching a Large Steering Wheel

By Joe V. Romig

TO REPLACE a small steering wheel with a larger one is neither expensive nor difficult, if the method illustrated is followed.

Four small brackets made of thin sheet steel or brass are cut to the shape shown, and the rectangular end is rounded to fit the contour of the lower side of the rim. The other end is then bent to the angle required and two holes are drilled through it and countersunk. Through these holes pass the wood screws used for fastening the bracket to the rim.



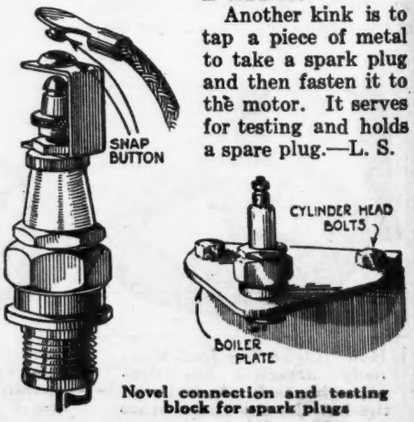
How the large rim is fastened to brackets, which are in turn bolted to the old spider, and the pattern for the brackets

When the brackets are assembled on the new rim and screwed fast, they are placed on the spider and carefully centered. The holes for the bolts are then marked and after they have been drilled, the new rim is bolted in place. Bolts ¼ in. in diameter are strong enough, and 3/16-in. sheet metal will serve for the brackets. Made in this way, the alteration is not difficult, costs little, and is strong and durable.

Two Spark Plug "Kinks"

BY USING auto curtain snap buttons as shown, a tight spark plug connection is insured.

Another kink is to tap a piece of metal to take a spark plug and then fasten it to the motor. It serves for testing and holds a spare plug.—L. S.



Novel connection and testing block for spark plugs

The Home Workshop

Arthur Wakeling, Editor

Attractive Pergola Garage Costs Little to Build

BETWEEN 800,000 and 900,000 autos will be sold to new owners in 1923, according to a reliable trade estimate. If you are one of this vast army of new motorists, and if you have no place to store your new car, you will find many interesting and money-saving suggestions in this article on garage building.—THE EDITOR.

NO HOME worker who has a reasonable amount of leisure time need go to great expense to provide himself with a garage. The one illustrated costs only from $150 to $200 for materials, complete with cement floor, doors, sash, and hardware.

The pergola roof effect at once distinguishes this garage as different from the stock designs usually seen, and at the same time has the great advantage of allowing a very simple type of construction to be used throughout.

The building is simply a shed with a flat roof sloping toward the rear. After it is framed and the roof and doors are on, a

Hanging the door

1 by 10 or 1 by 12 in. board is fastened at each side so that the upper edge is even with the highest point of the roof at the front. The board runs back on the level and therefore conceals the slant of the roof. The ends are shaped to conform with the design selected for the ornamental beams, and are doubled in front to give the effect of a 2-in. thickness.

After the roof has been covered with a prepared roofing, the top beams, which are purely ornamental, are put in place. Those in the rear are blocked up from the roof to take the greater part of the weight off the side boards. Two long strips, 1 by 2 in., are nailed on top near the ends of the beams to brace them.

Pilasters Ornament the Front

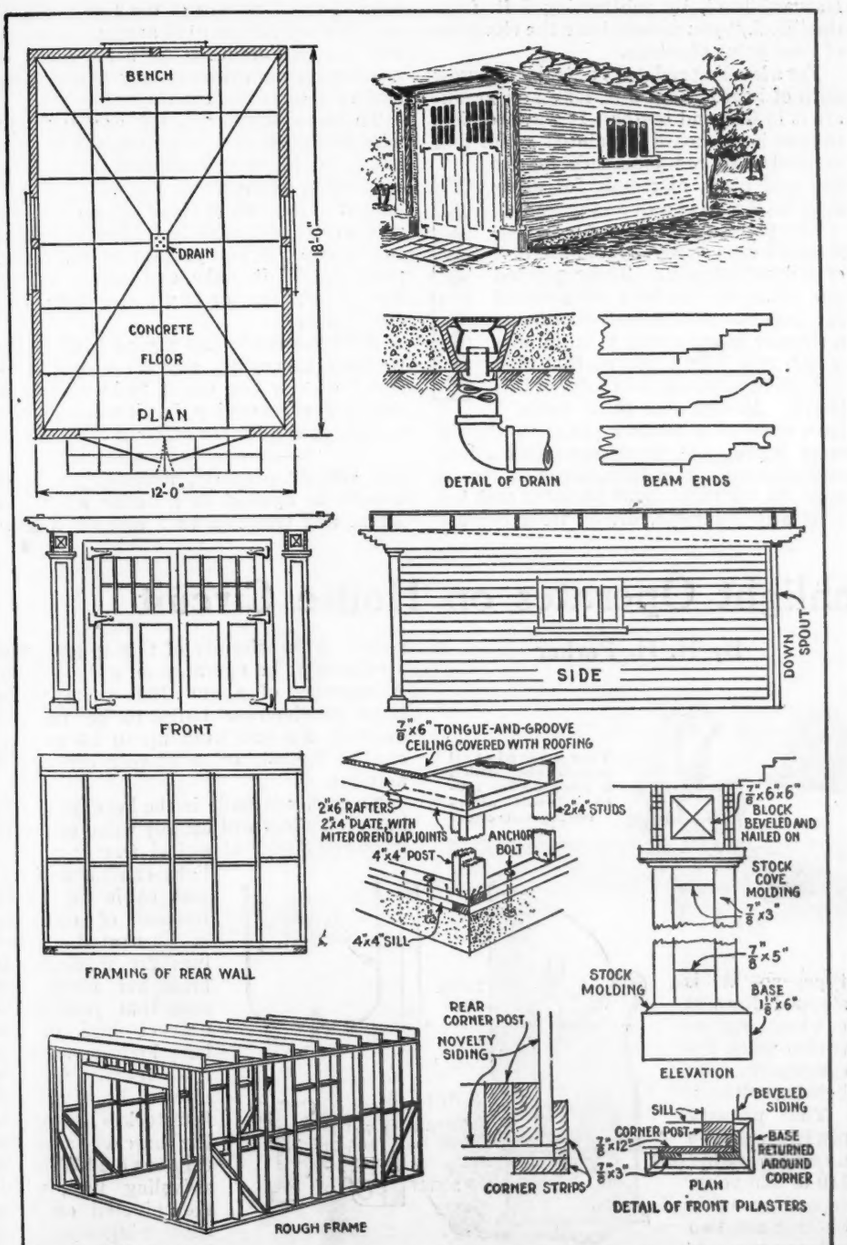
The front is further ornamented by two plain pilasters. As shown in the accompanying detail, they are simply 1 by 12 in. boards nailed to the corners. At their top, on the inside, are attached two false beam ends corresponding with those at the outside. Below these is a plain cap and molding. Narrow strips nailed to the pilasters give them a paneled effect, and a base of 1⅛ in. by 6 in., with a stock molding, is provided at the bottom. The base and cap are returned around the 1 by 4 in. piece on the side that forms the corner piece against which the siding is butted.

Dimensions that have been found generally satisfactory for this type of garage are 12 by 18 ft., the studs being 9 ft. long. If it is desired to do much work in the garage, it can profitably be made 20 ft. or more deep, so as to give more space around the workbench.

The doors are 4 by 8 ft., the opening being 8 by 8 ft. It is usually best to buy the sash and frames, although they can be made. Light cellar sash, with 8 by 12 in. glazed panes are used at the sides and back.

In the case of the doors, the usual type with cross braces showing do not look quite as well in this design as those with vertical panels. The doors can be obtained quite reasonably, usually for not much more than $25 a pair, but the home worker can, nevertheless, save a little by making them

(*Continued on page 102*)



Front and side views of the garage, the plan, and details of the framing, corner construction, ornamental pilasters and beam ends, and drain connection

Homemade Instruments for Running Simple Surveys

By Capt. Roger Sherman Hoar

Formerly Instructor in Plane, Railroad, and Geodetic Surveying at Harvard University and Senior Instructor of Advanced Military Surveying at the Coast Artillery School, U. S. Army

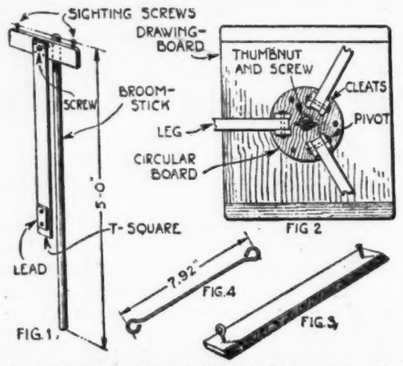
ALMOST any simple bit of surveying, such as locating boundaries, mapping small or large land tracts, running a profile for the location of drainpipes, drawing contours as a basis for grading or landscape gardening, can be performed fairly accurately by means of wooden instruments that can be made quickly and cheaply. These instruments are a Harvard hand level, a plane table, a pin alidade, a plumb bob, and a chain. Any one can easily adapt to these simpler devices the instructions contained in standard surveying textbooks, written for instruments costing hundreds of dollars.

The Harvard level (Fig. 1) has been used for years at the Harvard Engineering Camp for getting the contours for preliminary railroad surveys. It can be made entirely by hand at a cost of only a few cents, but the quickest way is to sacrifice a drafting-room T-square in its construction.

Bore a hole through the middle of the T, and drive a screw through this hole into one side of the end of an old broomstick. On the end of the blade of the T-square fasten a slab of lead. Now, when the broomstick is held vertical, the T-square will swing like a pendulum, with the top edge of the T practically horizontal. Drive a small screw partway into each end of this top edge, so that the two screws will stand vertically. Saw off the bottom of the broomstick, so that the distance from top to bottom of the entire instrument is exactly 5 ft.

Used like Regular Level

The two screws are for sights. They can be made exactly level by screwing one or the other in or out, and can be tested by methods described in any reliable textbook. Leveling can be done as usual, but with an additional advantage. In ordinary leveling, "height of instrument" is a bit of information useful merely as one step in getting the elevation of the new point at which you are sighting; it does not give you the height of the ground where the instrument is standing. But with the Harvard level, by subtracting 5 ft. from the "H. I.," you always have the elevation of your point of set-up.



Harvard level, plane table, alidade, and a link of a surveyor's chain

For a leveling rod, take a straight narrow strip of board about 8 ft. long and graduate it in feet and tenths. It will be easiest to read if the board is painted white and marked with red diamonds for the feet and black diamonds for alternate tenths, as shown at the right.

The plane table (Fig. 2) is constructed most easily by the sacrifice of a drawingboard. Three pointed legs about 4½ ft. long are fastened 120 degrees apart around the edge of a circular board about 6 in. in diameter, and 1 in. thick, so that they will swing out from the center of this board. In my own plane table, I have screwed 6 cleats in pairs to the circular board, and then have used a long screw driven across from one cleat to its mate, as the pivot for the head of each leg.

A large screweye, driven from beneath through the circular board and into the center of the drawingboard, serves to lock the table top in place when it is oriented. An iron washer between the head of the screweye and the bottom of the circular board will serve to make the device more permanent. Or, better still, sink a nut in the center of the drawingboard, and use a thumbscrew in place of the screweye.

It is true that this plane table does not possess a universal joint for leveling the top, but in professional surveying, most, if not all, of the leveling is done by shifting the legs, and the amateur will find this to be sufficient.

Ruler Serves as Alidade

The alidade (Fig. 3) consists merely of an ordinary school footrule, with a screweye in one end and a small round-headed nail in the other. You sight through the screweye, across the head of the nail. To turn off horizontal angles, lay an ordinary protractor on the table, under the alidade. A similar protractor, tacked on the side of the head of the T-square of the Harvard level can be used for vertical angles. A plumb bob can be purchased for a few cents, or made with an ordinary toy spinning-top and a screweye to hold the string.

To make the chain, cut iron telegraph wire or baling wire into nine-inch lengths, and bend loops in each end, so that the dimension, as shown in Fig. 4, is just 7.92 inches. Then 100 of these links will form a surveyor's chain of 66 feet, 10 square chains to the acre. If you prefer feet and inches, you can use 1-ft. links, and carry a footrule for the fractions, or buy a steel (or even a cloth) tape.

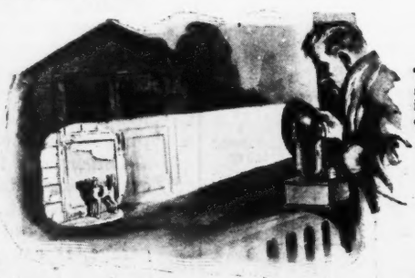
With this outfit and a good book on elementary surveying, any reasonably intelligent man or boy ought to be able to do any piece of surveying that is not important enough to call for the services of an expert.

TO ADHERE properly, asbestos insulation should be applied to a boiler when it is warm and troweled to a smooth finish.

Portable Searchlight Operates on House Circuit

By H. H. Parker

A SMALL low voltage searchlight is a convenient device to have about the house where there is a 110- or 220-volt alternating current lighting circuit. If a garage or chicken house is located in a dark corner of the premises or if a strong light is needed in an emergency, a length of lampcord attached to the searchlight can quickly be plugged into any lamp socket or baseboard connection so that the light can be taken to the back porch, barn, garage, or wherever needed.

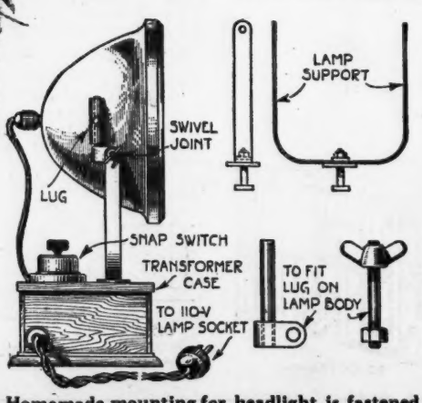


The completed searchlight, which is adapted for 110- or 220-volt alternating current

A regular automobile headlight or spotlight is used, mounted on a swiveling frame of simple construction, which is, in turn, attached to a wooden base containing a small alternating current transformer. The primary winding of the transformer is connected with the lighting mains through a snap switch and plug, while the secondary, or heavy wire, low voltage coil terminals are carried to the light. It would be impracticable to attempt to use the high voltage direct in a small reflector of this type, so it is stepped down to either six or twelve volts, the customary auto lighting voltages.

The primary mains can be used on either 110 or 220 volts, depending upon whether the two coils are connected in parallel or series; a transformer of this or any other kind cannot be operated on a d.c. circuit. A capacity of about 100 watts allows large candlepower bulbs to be used, if desired; a 6-volt bulb up to 16 amperes can be lighted, or a 12-volt carrying 8 amperes.

No change is made in the headlight itself, but the builder will usually want to mount it in some sort of swivel frame; a spotlight can be mounted just as it is. One method of mounting is illustrated. Two lugs are made up of brass bar stock, and rods that just fit the bracket lugs on the lamp body are screwed into them. Then a piece of brass or steel flat stock is bent up for the bracket and the ends are drilled for the swiveling lugs, which are pivoted on bolts with wingnuts. The bottom is drilled for



Homemade mounting for headlight is fastened with a swiveling joint to transformer case

(*Continued on page 116*)

FREE—Book on Wood Finishing

S. C. JOHNSON & SON, Dept. P. S. 5,
Racine, Wis. (Canadian Factory—Brantford)

Please send me free and postpaid your instruction book on Wood Finishing and Home Beautifying.

My dealer is.....

My Name.....

My Address.....

City & State.....

This book explains how inexpensive soft woods may be finished so they are as beautiful and artistic as hard wood. Tells what materials to use and how to use them. Includes color charts—gives covering capacities, etc. It is the work of experts beautifully illustrated in color. Fill out and mail this coupon.

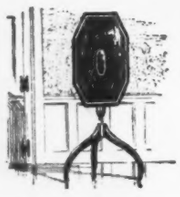
Tells How to Brighten Up Your Home

WELL finished furniture, woodwork and floors add materially to the beauty and attractiveness of your home. You, yourself, can easily refinish dingy, shabby, scratched wood. Our method involves practically no expense. All you need is a little time, a brush and

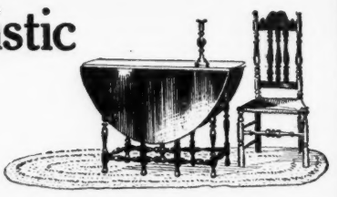
JOHNSON'S WOOD DYE

Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in 4 hours and does not rub off or smudge.

Johnson's Wood Dye is made in fourteen beautiful shades, all of which may be easily lightened or darkened—full directions on every label.



The Secrets of Making Realistic "Antique" Furniture



By James S. Godfrey

DO YOU know why antique furniture is now extremely popular—and justly so?

It is not because its rarity gives it unusual dollars and cents value, or because it is a reproduction that happens to imitate cleverly the appearance of costly old pieces. It is because it has that intangible but most desirable attribute called "character." It bears the stamp of the craftsman rather than the machine. Its surfaces are not hard and monotonous, but richly varied in tone and color, and the edges, moldings, and carvings have been softened by time.

A good antique has a sturdy, honest, livable look and a decorative value so marked that often a single piece, properly placed and displayed, will give beauty and dignity to an otherwise commonplace room. Decorators and architects have been quick to see and use this beauty of patina and softness of arrises.

An antique is not, of course, necessarily better than a modern piece of furniture. Indeed, the reverse is often the case, and a modern reproduction may be better in respect to utility, durability, and charm than a genuine heirloom.

The home worker does not have to spend much money to provide himself with antique pieces. It is largely a matter of proper finishing. A cheap piece of furniture can often be purchased and, with a little care and patience, refinished until it has the distinctive tone and "feeling" of an antique.

The simplest, easiest and surest method of obtaining an antique finish on a piece of modern furniture is to remove the ordinary finish, as far as can be done, and refinish, and do this several times, if necessary. Don't take too much pains in removing the first finish. If the scraper tears off a corner here and there, the sandpaper bites too deep, the stain does not flow quite evenly, and the new finish is rubbed off in places, so much the better.

To imitate the dark color of the majority of antique finishes, dark commercial mahogany and walnut stains and oak stains of various kinds can be used. Fine effects can be obtained, especially on new work, simply by rubbing a penetrating water or acid stain of standard quality into the wood, sanding it with fine sandpaper when dry and then applying a second coat diluted about one half with water. Follow with a thin coat of shellac to fix the stain, and apply thin coats of wax, well rubbed in, or other flat finishes or even varnish, well rubbed to a dull or eggshell finish.

A reproduction of this fine fourteenth century English chest is within the capacity of every home workshop

This is a good basic process to which the "antiquing" methods described hereafter can be applied in all sorts of combinations. It is frequently not necessary to fill the grain, but that depends upon the style of the piece being finished. For instance, fine Colonial furniture, such as made by Phyfe, was filled and finished most beautifully and in a way that can be imitated best only by the use of many coats of rubbed shellac or a real French polish.

Photos courtesy the Metropolitan Museum of Art

The charm of the antique is well represented in this oaken cupboard of the fifteenth century Gothic period

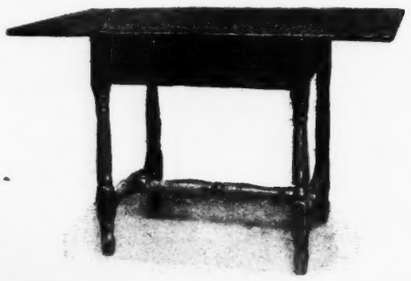
A satisfactory stain for reproductions of mahogany Colonial furniture is made by dissolving ½ oz. of potassium bichromate in 1 qt. of hot water. The solution is allowed to cool before applying to the wood, which must be sandpapered perfectly smooth.

If, for example, an inlaid mahogany table has been made, the chances are that the wood used is a relatively light variety of mahogany, often known as baywood, and not the dark San Domingo mahogany used by Colonial cabinetmakers and still used for especially fine pieces of furniture. The mahogany will have to be darkened artificially, so one coat of the potassium bichromate should be applied. It will be a dull brown color when it dries and if it does not seem dark enough, a second coat should be put on. Then sandpaper it a little and continue the finish as if the wood were naturally dark mahogany. The inlays should be shellacked with white shellac and a coat of dark mahogany oil stain applied, followed by half a dozen or more very thin coats of orange shellac. Each under coat should be rubbed down with pumice stone and oil, and the last coat with rotten stone and oil.

On open grained woods like oak, a wash of cream, gray or light brown flat oil paint can be brushed into the grain in place of a filler and rubbed off, so that the grain is more or less accentuated, and the use of "toners" in this way can be used to produce many effective finishes.

Ordinary stains can be supplemented with the best grade of asphaltum obtainable and oil of turpentine; this gives a brown and aged appearance to wood, but should be applied with discretion, and rubbed well into the grain of the wood with wax. Logwood or the green shells of black walnut boiled in water also gives a stain utilized for this work, both for oak and walnut. Tincture of iodine, from the medicine cabinet, is another good brown stain if it is well covered with shellac, wax, or varnish.

Apply a little nitric or sulphuric acid in places, so that the surface will be eaten away and colored at the same time. Brush the spots well, neutralize the acid with household ammonia, and wash them with warm water. In connection with this much used process, permanganate of potash, another invaluable stain for the "antiquing" process, frequently serves for giving colors.



The amateur craftsman can easily duplicate this American table, made about 1700

In place of fuming oak, it can be darkened simply by brushing it with liquid ammonia or bichromate of potash. New oak, when made up, can be aged by whitewashing it with fresh lime, which should be brushed off well after it is dry. Linseed oil or wax is then rubbed well into the grain. Several coats of a strong solution of washing soda will give a somewhat similar result.

Another antique finish is the so-called "Sugi" treatment of cypress. The Japanese have for ages used driftwood in making beautiful pieces of furniture. The surfaces of the wood, being

(Continued on page 108)

TYPED WORDS ARE WINGÉD WORDS!

In the building of the bridge, words—surely as steel—have their part.

In every field of life—the boy's study, the man's work, the woman's social activities—*words* play a leading rôle.

Let them be *wingéd* words—typed on the responsive keys of the Underwood Portable. Then they are words easily written and pleasurably read—words that are forceful, accurate and clear.

Because it is built by the makers of the world's Standard Typewriter; because it embodies features that are exclusively Underwood, this Portable makes it possible for anyone to do *Underwood Typewriting* anywhere.

PRICE $50
in the United States.
The Portable is obtainable at Underwood offices in all principal cities, or direct by mail.

Cased:
Weight 9⅞ lbs.
Height 4⅞ inches.

Send for
"Giving Wings to Words"
an illustrated booklet fully describing the features of the Underwood Standard Portable.

"The Machine You Will Eventually Carry."

UNDERWOOD TYPEWRITER COMPANY, INC., UNDERWOOD BUILDING, N. Y.

UNDERWOOD PORTABLE

Better Shop Methods

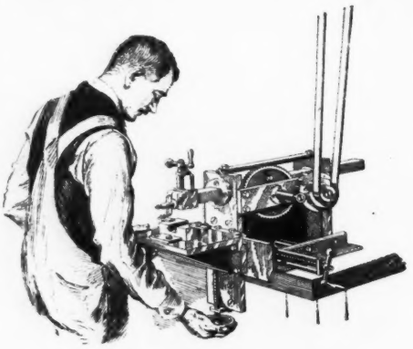
How Expert Mechanics Save Time and Labor

Sturdy Bench Shaper Cuts Production Costs

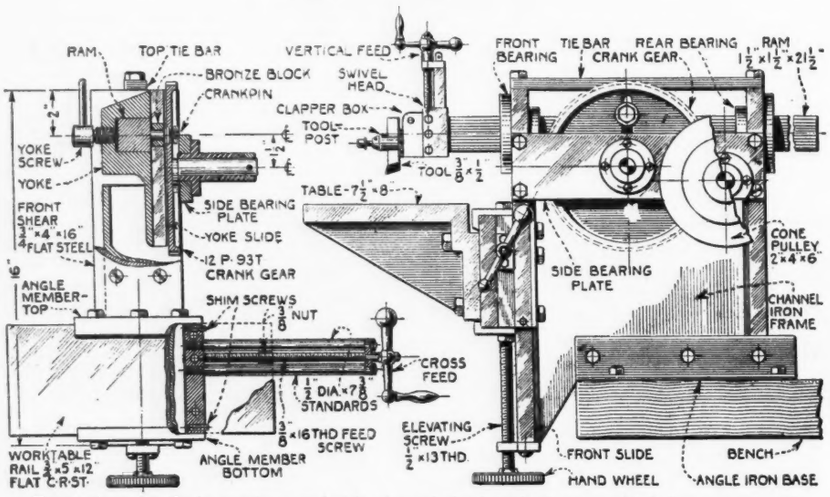
By Joe V. Romig

ANY machine shop, however small, is incomplete without a shaper. Even the experimental shop should have a shaper for the machining of flat surfaces.

Much of the work done nowadays on the shaper was once done by chipping and filing. Rather than go to the expense of buying a bench shaper, the mechanic in the small shop can make one of his own that will be a sturdy, true-running machine, with plenty of power to take good cuts. It will also be very accurate, if pains are taken with every detail in building it.



This 6-in. crank shaper was designed to eliminate as much troublesome and expensive machine work as possible. Use is made of cold rolled steel flats, which are procurable at any steel sales company's store, for most of the accurate surfaces. The only casting required is for the worktable, which cannot be made out of stock shapes because of its peculiar form.



Front view, partly in section, and side view of the bench shaper, which has a stroke of from 2 to 6 in., a tool head travel of 2 in., a vertical table travel of 6 in., a horizontal table travel of 7 in., an area limit of 6 by 7 in., and a three-speed drive

The shaper has a variable stroke of from 2 to 6 in. in length, and the ram can be placed in any position by means of a clamping yoke member. The head swivels and can be set at any angle for dovetails and similar work. A novel arrangement permits locking the head firmly in any of its angular positions.

A substantial gear reduction provides the power necessary for heavy cuts and three speeds are available for the efficient operation of the tools. A ¼-hp. motor is strong enough to run this machine, the drive being throughout an overhead countershaft.

In constructing the machine tool, a piece of 10-in. channel iron is cut for the frame, as shown, and shaped off true to bring the two outside faces parallel and square with one another. This channel iron, as well as the steel flats, can be bought for a few cents a pound. A piece of ¾ by 5 in. cold rolled steel should be bought in one piece, 60 in. long, so that the builder can cut it to suitable lengths, as required.

Test all flat stock for straightness and parallelism of sides. If out of true, straighten it with files and scrapers and check with straight edge and micrometers. A front and rear are cut, drilled, and countersunk, and are then attached to the channel iron frame piece with flat head screws. Make all countersinks deep enough, so that the flat screw heads will seat about 1-32 in. below the surface of the flat. To insure all screws being seated perfectly, tap on the screwdriver with a hammer and pull up dead tight. The front and back plate must line up exactly right, as the ram bearings are carried in these two pieces.

For the base, two pieces of angle iron are bolted to the channel, spacers being used to fill in the opening of the channel.

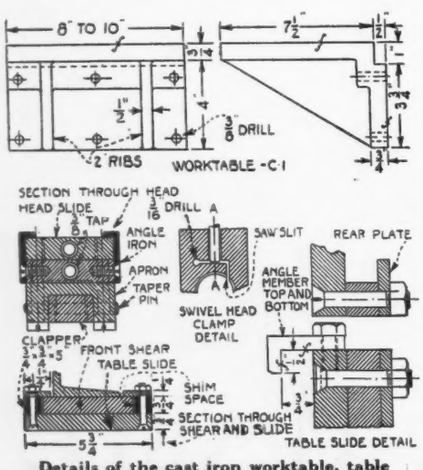
Bearings for the ram are made either of Babbitt metal or a good grade of bronze. They must fit snugly in the two holes bored for them in the front and back plates. These bearings are held in place with ¼-in. screws.

The ram is a single piece of 1½-in. square cold rolled steel, carefully checked for size and straightness. The front end is turned down to 1¼ in. diameter and is threaded as shown on page 86.

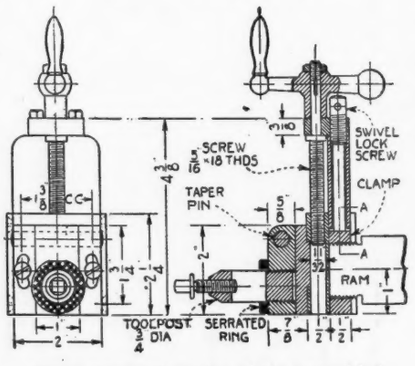
The head is built up of ½ by 2 in. flat stock. The slide plate is bored and threaded to fit the nose of the ram. The clamping arrangement is shown in detail. A hole is drilled to one side of the center line, and two saw slots at right angles to one another connect this hole with the threaded bore. A screw neatly placed in the center of the piece tightens against this weakened portion of the threaded bore and clamps the lug against the male threads on the ram nose.

A piece of ½ by 2 by 2¼ in. forms the sliding base of the clapper box. This is held to the slide with angle iron strips, as shown. It is drilled and tapped for the vertical feed screw, and is also counterbored slightly for the reception of the boss on the rear side of the clapper box proper.

(*Continued on page 87*)



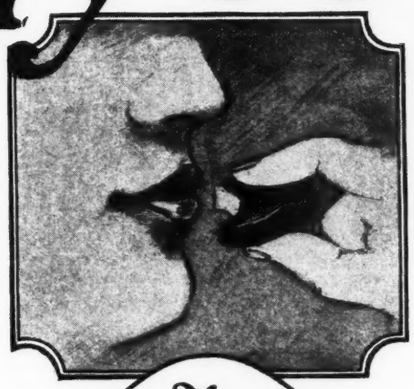
Details of the cast iron worktable, table slide, head slide, and clamp for the swivel head



Front view and section of the assembled head, showing the mechanism of the vertical feed

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Control



The SIX SENSES
Seeing
Feeling
Hearing
Smelling
√Tasting
and
Tycos
Temperature
Control

If sense of "taste" sufficed the canning industry!

If the fitness of cooked food—its readiness for canning—were gauged simply by its taste, then ptomaine poisoning would be a scourge of the human race instead of a rare occurrence. The essence of successful food preservation is perfect cooking, to render the foods sterile, to kill the bacteria which cause decomposition. The essence of successful food sterilization is the accurate indicating, recording and controlling of temperatures. There is a well defined temperature point at which foods should be sterilized to insure the bacteria being killed. This cannot be told by the sense of taste or sight or any of the other familiar senses, but it can be, and is, absolutely assured by the "sixth sense" of industry—Temperature Control—made possible by *Tycos* Instruments.

Food in cans is sterilized by being heated by steam in pressure chambers. The canner cannot depend on the usual senses for knowledge that the contents have reached and are being held at the right temperature. Again the "sixth sense"—again the temperature control, made possible by *Tycos* Instruments, plays its part.

It is a tribute to the accuracy of *Tycos* Temperature Indicating, Recording and Controlling Instruments that the use of successfully canned goods is worldwide today. It is significant that *Tycos* Instruments are regarded as the standard of accuracy in big canneries everywhere.

Is your business—your industry—equipped with the "sixth sense"? Certainly among the more than 8,000 different types of instruments in the *Tycos* Line are the ones exactly suited to your needs. *Tycos* Engineers are prepared to advise you in their installation. Literature on any type in which you are interested will be sent upon request.

Tycos in the Home

Tycos *Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

Tycos *Quality Compasses*
To show you the right way in unfamiliar country.

Tycos *Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos *Fever Thermometers*
A necessity in every home.

Tycos *Office Thermometers*
An aid in promoting human efficiency.

Tycos *Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos *Bath Thermometers*
To enable you to get the most good from your bath.

Tycos *Home Set*
Bake Oven Thermometer Candy Thermometer. Sugar Meter. The secret of accurate results in cooking.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos and the MEDICAL Profession

Tycos Sphygmomanameter, Pocket and Office Type.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on Request.

Taylor Instrument Companies
Main Office and Factory
ROCHESTER, N. Y., U. S. A.

Canadian Plant
TYCOS BUILDING
TORONTO
CANADA

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING

Valve Grinder
No. 747
Price, $5.00

A new, easy-to-use valve grinder

THIS new improved Valve Grinder is making a big hit with automobile owners everywhere. Simplicity of operation is the big feature.

Each upward stroke and each downward stroke of the operating handle gives 1-1/2 complete revolutions of the spindle. This makes easy, short, quick reciprocations, long reciprocations, or advancing reciprocations.

This new Valve Grinder is furnished with an extension that gives 5 inches additional length when desired—thus making a total of 11-1/4 inches below the gear.

The leverage obtained through the long operating handle and transmitted through a ball-bearing spindle makes grinding an easy job. Blade fits either slotted or spotted valves. Hardwood handles, mahogany finish.

Length over all without extension, 12-1/4 inches; length over all with extension, 17-1/4 inches; weight, 1-3/4 pounds.

Mr. Punch says: "Believe me, that new Valve Grinder will make any automobile owner his own mechanic."

1499 other good tools

Remember, this is but one of a big line of 1500 Good Tools—all made by skilled toolsmiths of long experience.

Send for catalog No. 15 which describes and illustrates other Goodell-Pratt Tools.

GOODELL-PRATT COMPANY

Toolsmiths

Greenfield, Mass., U. S. A.

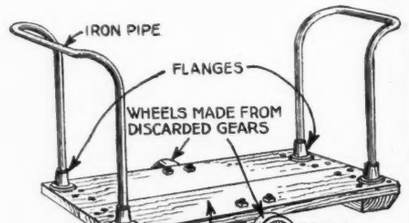
GOODELL-PRATT

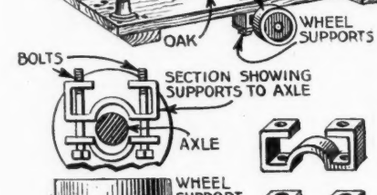
1500 GOOD TOOLS

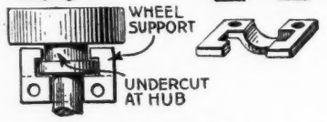
BETTER SHOP METHODS

Cheaply Made Shop Truck Handles Heavy Material

SIMPLICITY and cheapness of construction are the features of the small shop truck illustrated. The idea originated in a Washington, D. C., auto repair shop, where the truck is used for handling motors, transmissions, axle assemblies, and







The complete truck and detail of the wheels and axle bearing

the like. Being low, it is particularly good for hauling heavy materials.

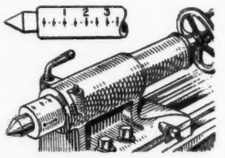
The body is made of two oak planks with heavy battens at each end. The combination rack and handle at each end is made from a single bent pipe attached with floor flanges.

The wheels are turned from two old gears, the hubs being undercut to engage fingers on the special form of hangers used. They are of strap iron.—F. L. M.

Drilling and Tool Setting Gage Placed on Lathe Tailstock

A DRILLING gage on the top of the lathe tailstock spindle has been a great help to me in my work. By starting the drill with the spindle set at the first mark, I am able to know at any time the exact depth of the hole as the work progresses without having to stop the lathe.

The tools required for making this gage are a 6-in. steel rule, dividers, center punch, cold chisel, hammer, and ⅛-in. hardened steel dies numbered from 1 to 4.



Saves time in drilling and in setting lathe tools

Take the tailstock spindle completely out of the lathe and transfer the inch marks by eighths from the rule to the center of the top side of the spindle by using the center punch and following it with chiseled cross lines. Then stamp the inch numbers as shown. Smooth the raised edges carefully with emery so that spindle will not bind when run in the first time.

Another aid is a short chiseled line with center punch dots on each end located on the side of the spindle exactly opposite the center of the lathe. This forms a fine gage for setting compound slide-rest cutters at the proper height.—J. M. ROLSTON.

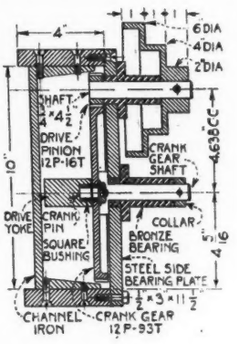
BETTER SHOP METHODS

Sturdy Bench Shaper

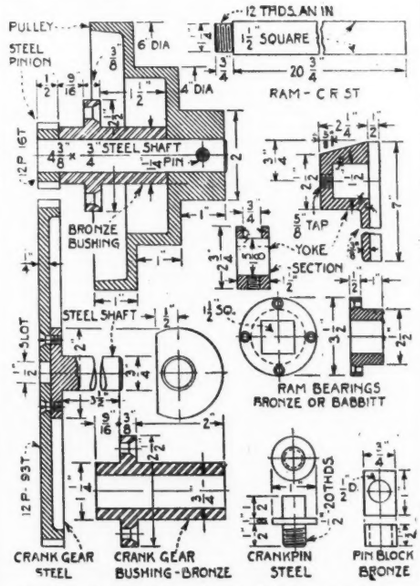
(Continued from page 84)

The clapper box is made of thicker steel and has a boss turned on its rear face. Two slots on a radius allow the clapper box to be swiveled for clearance on the return stroke when working on vertical faces. Two 5/16-in. screws with a fine thread clamp the box firmly in place.

The clapper is drilled and tapped for the threaded end of the toolpost, and should be a neat swinging fit, without any lost motion. A taper pin holds the clapper in place in the box. Clamp the box and clapper together when drilling and reaming the hole for the pin. The ball crank handles can often be picked up in the shop from worn out machinery.



The drive is through a belt to a three-step cone pulley, then to the 16-tooth pinion, of 12 pitch. This in turn operates the big gear of 93 teeth, 12 pitch.

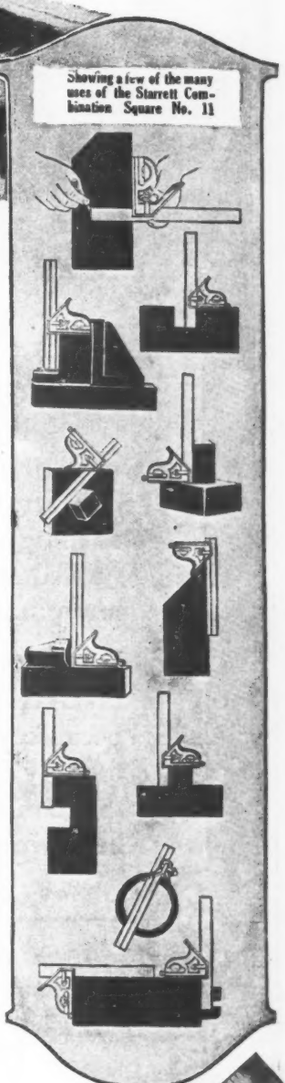


Sectional view through the driving mechanism (above) and details of the gearing, step pulley, ram and bearings, yoke, crank gear bushing, crankpin, and pin block

These gears are steel with a face wide enough to allow machining down to the sizes shown. The pinion is keyed to its shaft and the cone pulley can be fastened by a taper pin driven through both shaft and pulley. A bronze bearing for the shaft fits into a bored hole in the side bearing plate. This plate is made of steel or iron and is screwed rigidly to the edges of the two end plates. It is important to lay out the centers of the two bearing holes accurately, as the proper working of the gears depends upon their meshing correctly.

The crank gear is slotted in the web for the reception of the crankpin, as shown. A special shaft with an integral flange must be turned up for this gear. Gear and shaft are fastened together with flat head screws. The flange must be faced off on one side,

(Continued on page 88)



Seven Tool Uses at the price of a single tool

The Starrett Combination Square forms one of the most convenient and useful tools ever devised for machinists and mechanics.

Combining as it does the uses of a rule, square, miter, depth gage, height gage and level, it permits more rapid work on the part of the user and saves littering up the bench with a number of necessary but seldom used tools.

Not the least remarkable feature of this remarkable tool is the price—it's about what you'd pay for one of the seven tools it supplants. See this tool at any hardware store.

Fully described (with 2100 other fine precision tools) in the Starrett Catalog No. 22 "W" free on request. Write also for the Supplement showing the latest Starrett Tools.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled

ATHOL, MASS.

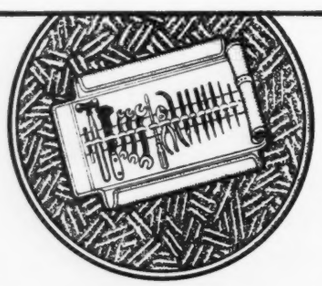
Use Starrett Tools

The Files that work in the Spring

NICHOLSON U.S.A. (TRADE MARK)

RIGHT NOW---EVERYWHERE NICHOLSON Files are busily at work sharpening harrow disks, cultivator teeth, saws, garden tools; shaping and refitting parts in overhauled motor cars, trucks, gas engines and pumps.

For every filing purpose, there's a *right* NICHOLSON File. A file which, because of finer temper, greater uniformity and keener cutting, has won the confidence and respect of the best workmen.



NICHOLSON U.S.A. WARRANTED CAST STEEL

NICHOLSON U.S.A. WARRANTED CAST STEEL

1 Use a NICHOLSON Mill Bastard File for sharpening harrow disks.

2 You'll find many uses for NICHOLSON Wood Rasps in constructing hen houses or cold frames.

3 Keep NICHOLSON Tungsten Point and Superior Platinum Point Files in your motor repair kits.

NICHOLSON FILE CO.

PROVIDENCE, R.I., U.S.A.

BETTER SHOP METHODS

Sturdy Bench Shaper

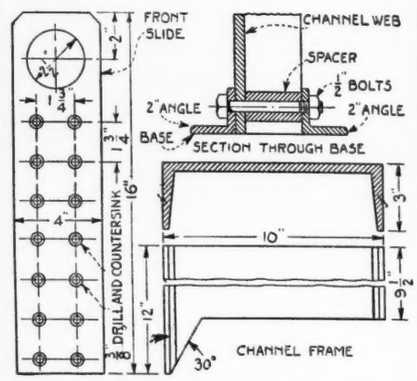
(*Continued from page 87*)

facing the slot, in order to allow the crank-pin to come back as far as possible. A collar, pinned to the drive gearshaft, holds it in place.

The yoke is a solid piece of steel, shaped to the size given in the details. Care should be taken to machine the interior surfaces of the slide to a high finish so as to reduce wear and friction at this most important place.

By having the yoke fastened to the ram by a single screw, the ram can be placed where desired, and can be extended beyond its usual range, as when planing a surface of greater length than its rated stroke, and when taking a double hitch at a surface.

As the working stroke takes place in one half of the whole revolution, the center



Details of the main frame and front slide, and method of supporting the channel iron

of support has been shifted, so as to make all strains central as far as possible. On the return stroke, the pin overcomes only the weight and resistance of the ram itself and works in the lowered end of the yoke, which is the farthest away from the support.

The pin block should be fitted neatly to both pin and slot and should be made of good bronze. Under the point of the clamping screw of the yoke, place a thin piece of brass shim stock, to prevent marring the accurate surface of the side of the ram.

The table slide is built up throughout. A piece 5 by 5¾ by ¾ in. forms the main part. This is drilled and tapped to the sizes given, and care must be taken to adhere strictly to dimensions. Angle pieces and cap screws hold the worktable slide or rail in place. Two pieces ¾ in. square are used, together with flat ¼ by 1¼ in. pieces to form the sliding box bearing. The screws are countersunk through the one piece, tapped and screwed through the ¾-in. square pieces, passed through drilled holes in the thin plates, and finally clamped with nuts on the outside. This leaves a space on either side in which a thin brass shim is placed, which can be adjusted with the screws to square up the slide and take up wear.

The manner of holding the table is just the reverse of the usual practice. In this design the rail is made to travel through the slide and carries the worktable clamped to its front face. This arrangement gives great strength and makes it possible to use and maneuver the relatively large worktable. By having a large worktable,

(*Continued on page 89*)

BETTER SHOP METHODS

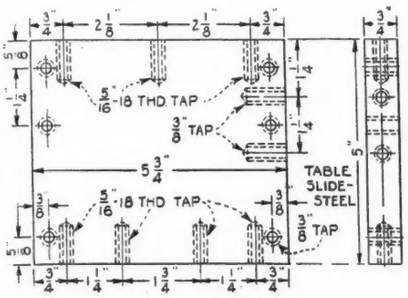
Sturdy Bench Shaper

(*Continued from page 88*)

jobs that usually would stump a machine of this size can be done.

The feed arrangement is mounted on two standards, as shown, and permits the travel of the table in either direction to a distance of 3½ in. or a total travel of 7 in., which is ample for a machine of this size.

The table itself is a casting made over a simple pattern, and it should be shaped up true and square. It is clamped to the table rail with cap screws, and several dowel pins keep it from shifting. To hold the work, many equally spaced holes should be drilled and tapped in the upper



Drilling and tapping the table slide must follow accurately the above layout

surface. A convenient size is ⅜ in. for the holes, spaced 1 in. apart. Countersink slightly to prevent burrs. A small vise is a necessary attachment for any shaper, and this can be clamped to the top face of the table in any position.

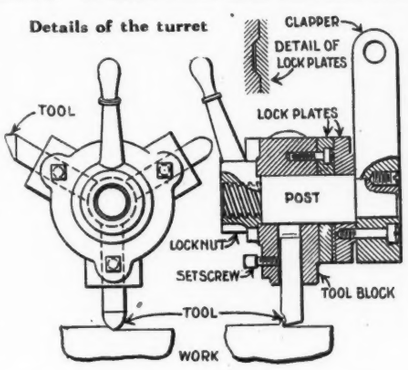
A bronze nut should be fitted to the rear of the table rail to engage the feed screw. An elevating screw that runs in a nut plate fastened to the bottom of the front slide plate, elevates and lowers the slide and rail when the clamping screws on the rear of the back plates are loosened.

The shaper should be mounted on the front of a solid workbench, and the countershaft can be mounted on the wall in the rear. Belts of 1 in. are sufficient for driving the machine.

Strong and rugged, accurate and true, this little shaper well repays the builder through the variety of work it turns out.

Turret for Shaper Saves Time on Duplicate Work

A TURRET for the shaper that saves time in changing tools when turning out duplicate work, may be made as shown. It holds three tools fastened with



setscrews, and when one shaping operation is completed, the locknut is loosened to permit the turret to be turned so as to bring another tool in position.—L. G.

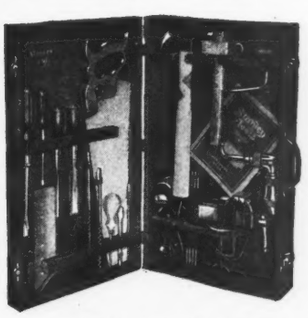
There's fun in using a Good Brace

There's real enjoyment in seeing the chips curl up and fall away, fun in making things with your own hands. More than that—there's mental relaxation from a long, hard day's work as well.

A Stanley Bit Brace is made for sturdy work by craftsmen who have received their training in the school of experience.

Stanley tools as shown in our No. 34 Catalog are well known for their dependable quality and workmanship. A copy of the catalog will be sent to those interested or see your hardware merchant.

Stanley Tool Assortments



The same tools that carpenters have used for years are now sold in Cabinets, Chests and Boxes. No. 903 Cabinet is shown at the left. Write for folder "7-E," illustrating these cabinets.

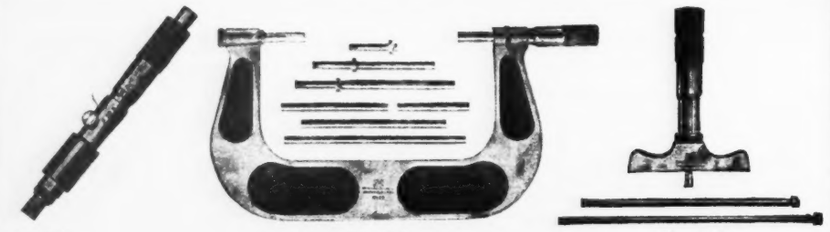
THE STANLEY RULE & LEVEL PLANT

THE STANLEY WORKS

New Britain, Conn.

New York—Chicago—San Francisco
Los Angeles—Seattle

STANLEY TOOLS



No. 270 No. 55 No. 607

TOOLS YOU CAN RELY ON

You'll find that most mechanics use Brown & Sharpe Tools because they can rely on them. These tools have the accuracy and dependability built in them that gives you complete confidence that your work will be correct. The more good, accurate tools you have, the more good, accurate work you can produce.

You Can RELY On Brown & Sharpe Micrometers

The addition of a Brown & Sharpe Micrometer to your kit gives you a reliable tool for accurate measurements.

The care and skill used in making the screw, fitting the spindle and graduating the thimble and sleeve are features which make every Brown & Sharpe Micrometer an accurate, dependable tool.

Micrometers of especial interest to the garage mechanic are the No. 55 which measures all pistons from 2" to 6" by thousandths of an inch and the No. 270 Tubular Inside Micrometers for accurately gauging cylinder bores.

Are you acquainted with the No. 607 Micrometer Depth Gauge and other "New Tools by Brown & Sharpe", for every close limit job?

Write today for Catalog No. 28

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

BROWN & SHARPE TOOLS

Prepare NOW for BIGGER BUSINESS

Small cash payment equips your shop with HB Twin Air Compressor, Tire Buffer and HB Battery Charger. Long, easy terms on balance, easily paid by profits from new business. Money-back guarantee. Free trial. Write TODAY.

HOBART BROS. CO.
Box P5 Troy, Ohio

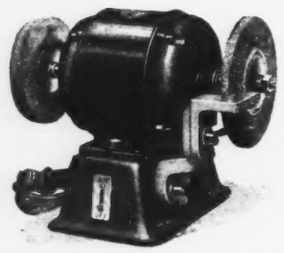
COLD PIPE BENDERS

Standard of the World.

HAND and MOTOR OPERATED

14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.

AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.



COMBINED GRINDER BUFFER **$25.00**

¼ h. p. A. C. Motor 6 in. Norton Wheel and 7 in. Cotton Buff.

Motor Alone **$13.50**

¼ h. p., 110 volt A. C. 60 cycle, 1750 RPM.

The above low prices will be withdrawn May 31st, after which higher prices will be made necessary by the marked increase in the cost of materials.

Send cash with order. Our money-back guarantee protects you.

Write for Bulletins describing these and other sizes.

NORTHWESTERN ELECTRIC CO.
408 So. Hoyne Ave., Chicago, Ill.

"Old Town Canoes"

The Call of QUIET WATER

A QUIET stream is a wonderful place to lazy-paddle a canoe. Just idle along. The "Old Town" glides forward at the slightest pressure of the paddle. The water murmurs a mild protest as it ripples off the bow.

An "Old Town" is the finest of canoes. It is easy to paddle—exceptionally strong and light and steady. It will last you for years. And it is the lowest-priced canoe you can buy. $54 up from dealer or factory.

The new 1923 catalog shows all models in full colors. Write for one to-day. It is free.

OLD TOWN CANOE CO.
1395 Main St., Old Town, Maine, U. S. A.

BETTER SHOP METHODS

Prize-Winners Reveal the Secrets of Their Success

JUST what sort of ability makes a man successful in shop work is revealed strikingly by the prize-winning contributions to the contest, "How I Got that Better Job," recently conducted by the Shop Methods Department of POPULAR SCIENCE MONTHLY.

The prizes have been awarded as follows:

FIRST PRIZE, $30: **J. Edgar Mitchell,** Huntsville, Ala.

SECOND PRIZE, $20: **James Ellis,** Memphis, Tenn.

THIRD PRIZE, $10: **L. Malkovsky,** New York City.

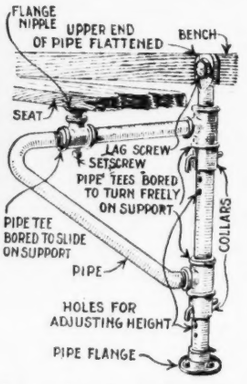
The contributions of these three men give, with extraordinary vividness, the methods by which they have increased their earning capacity, and worked up from the bottom to mechanical positions of responsibility. Their stories will be published next month.

Two other articles submitted in the contest will also be published, whenever space permits. These are in many respects the most exceptional of all the contributions, but in each case the writer, who is well known in shop circles, asked that his name should not be published. It was therefore impossible to award prizes, under the terms of the contest, to these men, yet their messages are too helpful and inspiring to be ignored.

This series of articles points the way to success for every mechanic, and represents the most successful step yet taken by this department to promote the cause of better shop methods.

Adjustable Stool for Shop Bench

A SHOPMADE bench stool that is adjustable to both height and distance from the bench is a special feature of the shop equipment at a machine shop of the Washington Navy Yard. The shop foreman found that increased production resulted in providing stools for mechanics engaged in the lighter tasks of fitting and gaging.



The stool turns under the bench when not in use

A pipe flange supports a vertical pipe, which is flattened at the other end and lagscrewed to the bench. The seat support, made as shown, slides up and down the standard, and is held at the height desired by means of two collars with pins. The bearings of the seat bracket are simply pipe tee connections drilled out so as to slide and turn freely on the standard.

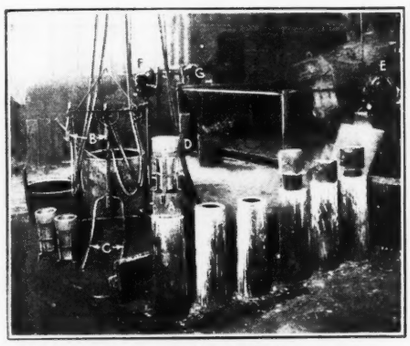
The wooden seat is 12 in. in diameter and fitted with a flange, pipe nipple, tee, and setscrew. This allows the seat to be adjusted in and out, and it can be swung under the bench when there is no necessity for using it.—G. A.

BETTER SHOP METHODS

Heat Properly Applied Reduces the Pipe in Cast Ingots

BY USING "hot top" rings, like those shown at *A*, as well as heating the inside of the molds before pouring the ingots, and heating them outside before, during, and after pouring, the defects or pipe in chromal (which is 80 per cent nickel and 20 per cent chromium) can be reduced one third. Only 10 per cent of each ingot needs be cropped off to get rid of the pipe, whereas ordinarily it is necessary to crop 30 per cent from the top. This is a saving of 20 per cent in the length of the ingot. The apparatus used is just as applicable for other metals or alloys, as chromal has practically the same shrinkage as steel, brass, or bronze.

The molds shown are for casting ingots 4 in. square and 2 ft. long. The hot ring *A* is an iron casting 8 in. in diameter and



The molds are well heated before pouring and kept hot during and after pouring

8 in. long, lined with molding sand and baked on top of the induction electric furnace in which the metal is melted. The insides of the molds are made as hot as possible by locating the gas burner *B* directly over them and shooting gas flames into them. Pipes *C* are then placed so that the gas flames will heat the outside of the mold.

While this is going on, the pouring ladle is filled and skimmed. The gas burners *B* are then removed and the hot ring is placed in position. The pouring funnel *D* is placed on top of the ring and the molten metal is poured. The burners *C* keep the outside of the molds hot until the ingots are comparatively cold. The pouring funnel *D* is molded from graphite and baked on top of the melting furnace.

At *E* and *F* are shown small blowers directly driven by ½-hp. motors, which mix the gas with air and give it a blast that drives gas flames down into the ladles to dry out their linings. Pipe *G* delivers one of the flame blasts.—E. F. LAKE, Detroit, Mich.

Cracks in Castings

TO PREVENT a crack in a casting from extending, the usual practice is to drill a hole at each end, but this frequently fails because the holes were not drilled in the proper place.

In order to determine exactly how long a crack is, cover the surface with a mixture of equal parts of kerosene and oil. Allow it to stand for a time, wipe the surface clean, and brush on the whitewashing mixture used when laying off lines. The crack will show up as a clearly defined yellow streak.—A. C.

How Men Get

Those clean, white teeth you see

Not long ago beautiful teeth were seen less often than now. People did not like to show them. Now everywhere you see teeth that shine.

The reason lies in a new teeth-cleaning method. Make this free test and see what it does for you.

That cloudy film

Your teeth are coated with a viscous film. You can feel it with your tongue. It clings to teeth, gets between the teeth and stays.

Food stains, etc., discolor it. Then it forms dingy coats. Tartar is based on film. Those coated teeth don't shine.

Film also holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay. Germs breed by millions in it, and they cause many troubles.

Very few escaped

Under old methods few escaped these troubles. So dental science searched for ways to fight that film. Two ways were found. One acts to curdle film, one to remove it, and without any harmful scouring.

Able authorities proved these methods effective. Then a new-type tooth paste was perfected, based on modern research. Those two great film combatants were embodied in it.

The name of that tooth paste is Pepsodent. Leading dentists the world over now advise it. Millions of people in some fifty nations use it every day.

Kills acids, too

Pepsodent also multiplies the alkalinity of the saliva. That is there to neutralize mouth acids, the cause of tooth decay.

It multiplies the starch digestant in the saliva. That is there to digest starch deposits on teeth which may otherwise ferment and form acids.

Thus Pepsodent gives manifold effect to these great tooth-protecting agents in the mouth.

Avoid Harmful Grit

Pepsodent curdles the film and removes it without harmful scouring. Its polishing agent is far softer than enamel. Never use a film combatant which contains harsh grit.

Learn what it means to you. Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

You will see and feel enough to convince you that you should always brush teeth in this way. Cut out the coupon now.

Pepsodent PAT. OFF. REG. U.S.

The New-Day Dentifrice

A scientific film combatant, which whitens, cleans and protects the teeth without the use of harmful grit. Now advised by leading dentists the world over.

10-Day Tube Free 1082

THE PEPSODENT COMPANY,
Dept. 840, 1104 S. Wabash Ave., Chicago, Ill.
Mail 10-day tube of Pepsodent to

.....

.....

ONLY ONE TUBE TO A FAMILY

Sargent Auto-Set Bench Plane

This plane always makes shavings—even across the grain!

MANY a plane will cut smoothly *with* the grain and when the grain is straight and true. The test comes when you push the plane *across* the grain.

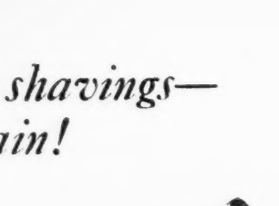
But the Sargent Auto-Set Bench Plane always makes crisp shavings, always cuts clean and true—even across the grain. Its cutter of chromium alloy steel never chatters, so rigid is the mechanism. And it holds a keen edge through the most difficult work. You may remove it, when sharpening is necessary, and replace it without disturbing the adjustments.

For the finishing touches to your craftsmanship, use the Pocket Plane and the Steel Block Plane. They are handy, small in size and as dependable as all Sargent tools.

See these planes at hardware dealers everywhere.

Full information is contained in the Sargent Book of Planes, which will be sent free upon request.

Sargent Steel Block Plane



Sargent Pocket Plane

SARGENT & COMPANY
50 Water Street New Haven, Conn.

SARGENT
Tools & Hardware

DIAMONDS
Here at 60% of Market Price

This snappy perfectly cut diamond 7-8—3-32 ct. at $52.50 among bargains we list. Many other big values in our lists. Buy *HERE*. Loan values the price basis, not market values. This 75 year old *diamond banking firm* has thousands unpaid loans and other bargains must sell NOW.

Why Pay Full Prices

Any diamond sent for absolutely free examination at our risk. No obligation. No cost to you.

Send for Latest List

Diamond Bargains described in detail. *Tells of guaranteed loan values*, unlimited exchange privilege, details of free examination. *Send now.*

JOS. DeROY & SONS 4798 DeRoy Bldg.
Only Opposite Post Office, Pittsburgh, Pa.

AGENTS $6 a Day

Should be easily made selling our Concentrated Non-Alcoholic Food Flavors, Soaps, Perfumes and Toilet Preparations. Over 100 kinds, put up in collapsible tubes. Ten times the strength of bottle extracts. Every home in city or country is a possible customer. Entirely new. Quick sellers. Good repeaters. Not sold in stores. No competition. 100 per cent. profit to agents. Little or no capital required. Elegant sample case for workers. Start now while it's new. Write today—a post card will do—for full particulars FREE

AMERICAN PRODUCTS CO., 7597 American Bldg. Cincinnati, O.

The Pro-phy-lac-tic Tooth Brush

A clean tooth never decays—the Pro-phy-lac-tic keeps teeth clean

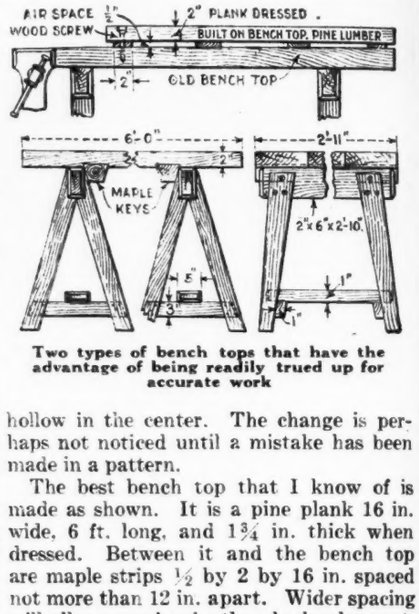
BETTER SHOP METHODS

How a Pattern Maker Can Keep His Bench Top True

THE machinist is supplied with angle plates, surface plates, faceplates and all sorts of work-supporting and work-holding fixtures. The pattern maker is usually fortunate if he can find enough clearance at the end of his bench on which to build, square up, and measure his patterns.

If his bench is at all warped or twisted, it will not serve properly for this purpose.

Fastening a pine board on the top of the bench is a practice common among pattern makers and the board can be dressed when required. This, however, is not a good plan, because the air circulates only on the exposed surface of the board. Today the board is dressed by hand straight and true; tomorrow or the next day it is twisted and



Two types of bench tops that have the advantage of being readily trued up for accurate work

hollow in the center. The change is perhaps not noticed until a mistake has been made in a pattern.

The best bench top that I know of is made as shown. It is a pine plank 16 in. wide, 6 ft. long, and 1¾ in. thick when dressed. Between it and the bench top are maple strips ½ by 2 by 16 in. spaced not more than 12 in. apart. Wider spacing will allow a spring in the plank when patterns are being nailed. The plank is fastened in place with screws and given a final dressing. A bench fitted up in this way will remain straight and true.

Another fine pattern maker's table consists of a pair of wooden horses built extra heavy and strong. The tops of the cross rails are level and parallel. The top is made of three pieces of 2-in. pine dressed flat and true and held loosely in position by dowel pins that are tight in one plank and loose in its companion. A maple key is driven into dovetails cut in the planks, so that when the three planks are assembled and squarely fastened together, the top surface is flat, true, and out of winding.

When the top requires redressing, all that is necessary is to drive out the maple keys, pass the planks one at a time through the planer, and assemble them again, all of which can be done with very little labor and in the shortest possible time.

One of the important details in connection with the redressing of the table top is to do the work just before the knives in the planer are taken out to be changed or sharpened.

Seven years ago I made up a bench and worktable as described and they are still giving good service.—M. E. DUGGAN, Kenosha, Wis.

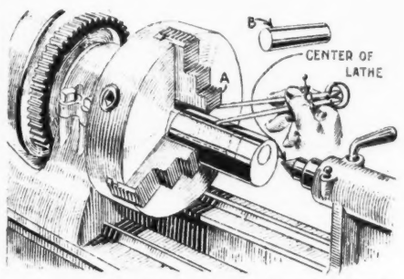
CHARCOAL rubbed on a partly worn file will make it bite better.

BETTER SHOP METHODS

Three-Jaw Chuck Used for Boring Eccentric Holes

FOLLOWING customary machine shop practice, I have always used a four-jaw chuck for holding work to be bored eccentrically, until I discovered that it was very easy to do the same work with a three-jaw chuck.

The work being laid out as shown, bring up the tailstock center and open the jaws



By using a plug of the proper diameter, work can speedily be chucked eccentrically

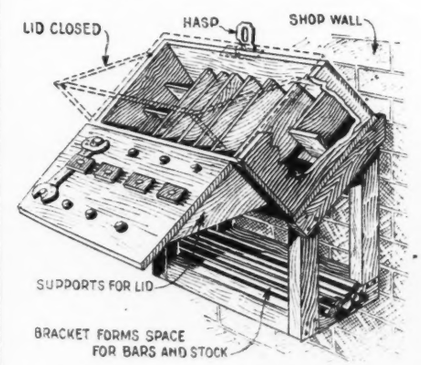
of the chuck so that the work drops down between the two lower jaws until the center punch mark of the hole to be drilled comes in line with the center of the tailstock.

Then measure the distance from the top of the work to jaw *A*, place a plug, *B*, of a diameter equal to that distance, between jaw *A* and the work. This will automatically serve to clamp the work in the correct position and is accurate enough for any job not important enough to require a center tester for truing up the work.—S. L. ROBERTS.

Tools Are Readily Accessible in Unique Inclined Toolchest

SINCE the speed with which a job is completed depends considerably on the accessibility of the tools, a well arranged toolbox is certain to save time and labor. The box illustrated, which is used by an automobile service station with a reputation for speed and thoroughness in making repairs, is supported on an inclined rack.

One advantage is that practically every tool in the box is visible across the width



Kept in this chest, tools and supplies are visible and can be selected quickly

of the shop. Another is that a special place is provided for each tool, so that the absence of any one is noticeable. This reduces the loss of tools. In addition, the box has small compartments for split cotters, taper pins, lock washers, screws, and nuts.—F. L. U.

I Pay Your Railroad FARE

CHICAGO
The electrical center of the world

B. W. Cooke, Pres.

COME TO CHICAGO—the Electrical Center of the World—I pay your railroad fare from any place in the United States. Grasp this opportunity to see the country at my expense. Don't stick in one spot—travel—get experience. Come to Coyne—learn electricity in 3 months. Fit yourself for a big paying job. The largest electrical school in the country specializing in electrical instruction *only*.

Learn Electricity In 3 Months

Get a complete training so you can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or you can go into business for yourself as electrical contractor, dealer, auto ignition or battery expert and make from $3,000 to $20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

Great Shops of Coyne

No books or useless theory. You are trained on $100,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switch-boards, power plants—everything to make you an expert ready to step right into a position paying from $45 to $100 a week.

Radio Course Free. We include the following free with the regular course:
(1) A complete course in auto, truck and tractor electricity and storage batteries. Greatest outlay of auto, electrical and battery equipment in the country.
(2) Course in Radio—the marvel of the age. Constructing, installing and operating. Build your own wireless telephone set.
(3) Life membership in the Coyne school. Stay as long as you wish and return for further training at any time in the future.

Earn While You Learn! We help students to secure jobs to earn a good part of their expenses while studying

Student winding a Stator

SEND COUPON

Don't delay a minute; send that coupon *right now* for our big free catalog and full particulars of Free Railroad Fare offer. Remember this special offer is limited so act now.

COYNE Electrical School
Endorsed by Electrical Industry
1300-1310 W. Harrison St., Dept. 13-65, Chicago

B. W. Cooke, Pres.
COYNE ELECTRICAL SCHOOL
1300-1310 W. Harrison St. Dept. 13-65, Chicago

Dear Sir: Please send me free your big catalog and full particulars of your special offer of Free Railroad Fare and two extra courses.

Name .....

Address .....

.....

$1.00 A SUIT

5 Big HANES Features

1 **Hanes large, roomy armholes** taped instead of turned under. Can't curl or rip—but a friction-free surface that really wears.

2 **Hanes webbing belt** guaranteed 2-thread elastic webbing instead of single thread, gives more elasticity and greater strength. Specially sewed to prevent tears and rips.

3 **Hanes closed crotch** is cut and stitched in a special way that really keeps it closed. That means added hot-weather comfort.

4 **Hanes crotch lap buttons** sewed on the seam. Won't come off. 4 thicknesses of material instead of customary 2. No patch used.

5 **Hanes wide, full-length knees** cut so as to give greatest freedom without binding or creeping up the leg.

TRADE MARK HANES

You've got it all in "HANES" at $1.00

Full Cut
ATHLETIC UNION SUITS

WHAT we put into "Hanes" Athletic Union Suits for $1.00 cannot be duplicated anywhere near the price! As manufacturers we know this; you will prove it when you personally understand the comfort, workmanship, material and service that "Hanes" hands out!

Check up "Hanes" in comparison! We tell you "Hanes" is made to meet the world! Examine every detail from the quality of the nainsook down to the four thicknesses of material that holds the crotch lap button! "Hanes" is generously full cut and allows for the hardest work and play. Every strain-point is reinforced!

Put the youngsters in "Hanes" Athletic Union Suits—they give such wonderful service. 2 to 16 years, in sizes 20 to 34.

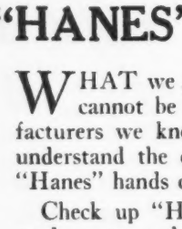
HANES GUARANTEE: We guarantee Hanes Underwear absolutely—every thread, stitch and button. We guarantee to return your money or give you a new garment if any seam breaks.

If your dealer can't fit you with "Hanes" Underwear, write us immediately.

P. H. HANES KNITTING CO., Winston-Salem, N. C.
New York Office, 366 Broadway

Next Winter Wear Hanes Winter Underwear

Kellogg Radio Equipment for Better Results



No. 501

The Kellogg rheostat is of simple design, having but one moving part.

It is so arranged that a maximum contact surface is provided, making perfect contact. To assure perfect current to the most critical tube, the rheostat operates on the half turn of the resistance element.

No. 501 ..... Each $1.50

Ask your dealer for Kellogg Radio Equipment

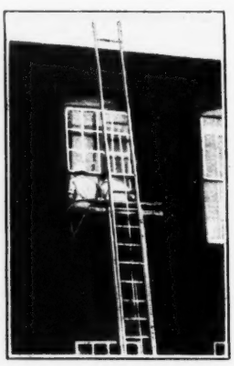
Use, Is the Test

KELLOGG SWITCHBOARD & SUPPLY COMPANY
CHICAGO

BETTER SHOP METHODS

Ladder Scaffold Simplifies Work of Painting Factory Windows

IN PAINTING the windows of a two-story mill, we use the ladder platform illustrated. The ease and speed with which this can be moved is remarkable and has repaid the cost of construction many times.



The platform is moved from window to window

The main frame of the platform is made of two pieces, 2 by 3 in. by 4 ft., and one piece 2 by 4 by 4 ft. 6 in. The platform is 38 in. wide and the cross member, which extends 8 in. on each side, is held to the ladder by ⅜-in. hook bolts.

A rope fastened over a small pulley in the top rung of the ladder raises and holds the platform when the ladder is moved from one window to another.—DONALD C. HARDIE, Avoca, Pa.

How to Color Steel Blue

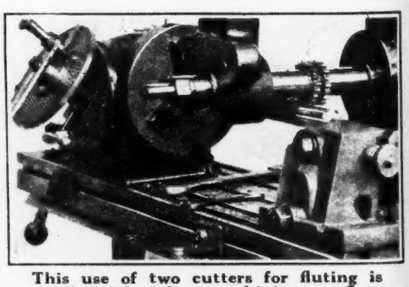
POLISHED steel articles, if smooth and clean, may be given a blue finish by placing them in heated charcoal.

The charcoal is powdered and placed in a box of steel or iron plate. The steel being blued must be taken out from time to time and dusted with finely powdered whiting. When the desired shade of blue is reached, the piece is removed and allowed to cool; it is then cleaned and oiled.

When the danger of warping through heat must be avoided, the steel is first cleaned thoroughly and then covered with a solution of 10 parts water to 1 part nitric acid. After it has turned a bluish shade, wash it thoroughly with warm water, using a soft cloth; then wipe it dry. Finally, rub it well with linseed oil.—F. H. SWEET, Waynesboro, Va.

Milling Flutes with Two Cutters

IN CUTTING flutes on a reamer or on any cylindrical surface, the usual practice is to machine one flute at a time. By



This use of two cutters for fluting is much quicker than machining one flute at a time

rigging up a milling machine as illustrated, the time can be cut nearly in two.

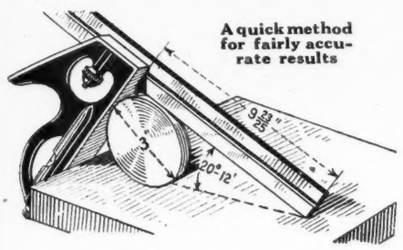
A regular dividing head is used and two cutters are placed on the main spindle of the machine, so spaced as to cut out both sides at the same time. This is a simple arrangement, but it has been a money-saver for the firm using it.—J. H. MOORE, Toronto, Can.

BETTER SHOP METHODS

Setting Angles with Combination Square and Disk

IN SETTING up angles where absolutely accurate results are not needed, an ordinary combination square is often used with a disk of known diameter.

The head of the square is set on a point found by multiplying the radius of the disk by the cotangent of half the angle wanted and then adding to this the radius of the disk. The cotangents of the degrees and minutes are in all ordinary machinery handbooks. Any inaccuracy of this procedure comes from setting the square head at the nearest scale fraction and is small enough to make the method practical where the precise accuracy of the sine bar is not needed.



A quick method for fairly accurate results

For example, if the angle wanted is 20 degrees, 12 minutes, and a 3-in. disk is at hand, the only question to be solved is where to set the head of the square on the blade. If the required angle is 10 degrees, 6 minutes, the cotangent of which is 5.61397, multiplying this by the radius of the disk or 1.5 gives 8.420955. To this is added the radius of the disk, or 1.5, giving 9.920 or 9 23/25 in. This is the distance at which to set the head of the square.—HENRY S. LARABY, New Haven, Conn.

Lanolin Conquers Skin Troubles Common to Metal Workers

LANOLIN, or equal parts of lanolin and castor oil, rubbed on the hands and forearms, will prevent the more or less common skin affections known as "oil ache" that result from constant contact in the shop with cutting oils and lubricating compounds.

The United States Public Health Service, which has made an investigation of the causes and prevention of such skin troubles, reports that in plants where the lanolin preventive was used, all cases of this type of skin trouble disappeared in a short time and that no new cases occurred.

It is recommended that each workman before starting his day's work, wash his hands and forearms thoroughly with warm water, using a sawdust and liquid soap preparation to assist the cleansing process. The lanolin, or lanolin and castor oil, should then be rubbed well into the skin. At noon, before luncheon, it is urged that the workman wash again with warm water and soap, and upon returning to work repeat the washing and application of lanolin.

The importance of some such routine is emphasized by the fact that about 27 per cent of the workers examined were found to be suffering from the characteristic skin troubles of metal workers.

Vigorous washing and the use of lotions at the end of the day were found not to be so effective in the end as the preventive measures.—C. H. G.

If the subscriber paid direct

Suppose that every Monday morning all the people who have a hand in furnishing your telephone service came to your door for your share of their pay. From the telephone company itself, would come operators, supervisors, chief operators, wire chiefs, linemen, repairmen, inspectors, installers, cable splicers, test-boardmen, draftsmen, engineers, scientists, executives, bookkeepers, commercial representatives, stenographers, clerks, conduit men and many others, who daily serve your telephone requirements, unseen by you.

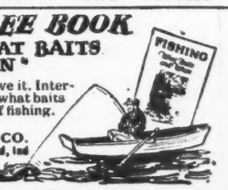
There would be tax collectors to take your share of national, state and municipal taxes, amounting to over forty million dollars. There would be men and women coming for a fair return on their money invested in telephone stocks and bonds—money which has made the service possible. Then there are the people who produce the raw materials, the supplies and manufactured articles required for telephone service.

They would include hundreds of thousands of workers in mines, smelters, steel mills, lumber camps, farms, wire mills, foundries, machine shops, rubber works, paint factories, cotton, silk and paper mills, rope works, glass works, tool works, and scores of other industries.

When you pay your telephone bill, the money is distributed by the company to the long line of people who have furnished something necessary for your service. The Bell System spares no effort to make your service the best and cheapest in the world, and every dollar it receives is utilized to that end.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
One Policy, One System, Universal Service, and all directed toward Better Service

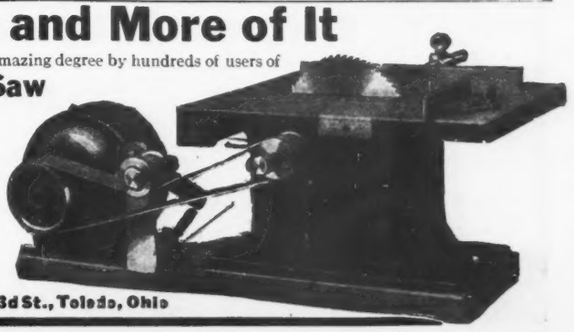
Send for FREE BOOK
"FISHING - WHAT BAITS AND WHEN"
Every fisherman should have it. Interesting angling hints. Tells what baits to use for every kind of fishing. Postal gets it!
SOUTH BEND BAIT CO.
14535 High St., South Bend, Ind.



$25 A DAY Selling Shirts
Large shirt manufacturer wants agents to sell complete line of shirts, pajamas, and night shirts direct to wearer. Advertised brand—exclusive patterns—easy to sell. No experience or capital required. Entirely new proposition. *Write for free samples.*
Madison Shirt Co., 503 Broadway, N.Y.C.

Better Work and More of It
—these are the results obtained to an amazing degree by hundreds of users of
Boice Junior Bench Saw

A wonderfully practical, compact, all metal machine designed for accurate and speedy sawing, ripping, grooving, etc. Cuts 1½" stock. Dadoes ⅝" deep and ⅝" wide. Driven by ¼ or ⅓ h. p. motor. Special saws cut type-metal, bakelite, brass, etc. Portable. Attaches to lamp socket.



Write for descriptive literature on the Junior Bench Saw, 4" Jointer, 14" Bench Band Saw, Bench Drills, Motors, and larger Bench Saws.
W. B. & J. E. Boice, Dept. P.S.S, 114 23d St., Toledo, Ohio

"Red Devil" Pliers made in 100 styles—one for every need. Known and used the world over. Style No. 1024—6½ inch shown above, $1.00.

The

"Red Devil" Wrench Set Fits Every Nut Right

A REALLY fine wrench set with which you can tackle the toughest jobs and save time.

"Red Devil" open-end "S" wrenches are handier than a monkey wrench. They fit every bolt and nut right and hold fast. Openings will not spread. They are thin—just the tools you need for working in hard-to-get-at places. Forged from open hearth steel, heat-treated for strength.

Each set consists of five wrenches, with sizes of openings ranging from 7/16 to 1 inch. "Red Devil" Wrench Set No. 92, price **50c** at hardware stores or from our factory.

For those who prefer to work with a straight wrench, we have also this pattern in the above type of wrench, five wrenches to a set, **50c** a set, at hardware dealers. If not in stock, send dealer's name and order direct.

Mechanic's tool booklet free.

SMITH & HEMENWAY CO., Inc.
Manufacturers of "Red Devil" Tools
264 Broadway New York, N. Y.

"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown below, 20c

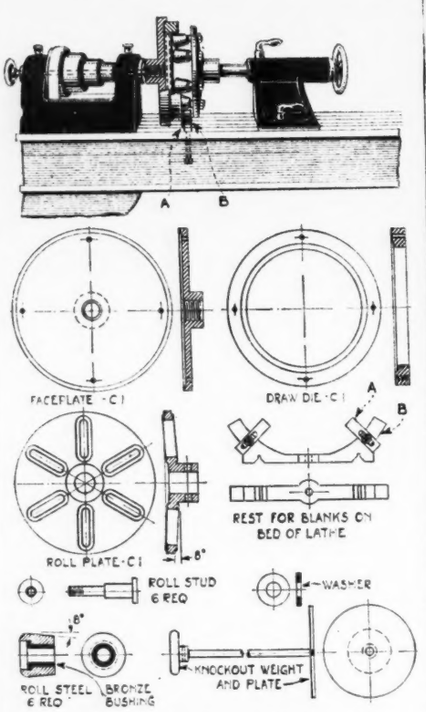
BETTER SHOP METHODS

Inexpensive Fixture on Wood Lathe Used for Drawing Shells

WHEN a few shallow shells have to be drawn, the necessity for making expensive tools can often be avoided by the simple method illustrated. This will serve for shells up to ¾ in. deep.

Any ordinary wood turning lathe can be used if the spindle and bed are true. As large a faceplate as the lathe will take is recessed ⅛ or 3/16 in. deep, as shown, to fit the largest die required. The die itself is cast iron.

A cast iron bar, fitted and bolted to the latheways, has two fingers set even with



How the shell drawing attachment is set up, and details of the parts

the edge of the draw die, so that the blanks can rest on them.

A roll plate is made for the tail spindle. The six rolls are so arranged on studs that they can be moved in or out to draw shells of the size needed. The rolls and the roll plate have an 8-degree angle, as indicated, to prevent the rolls from binding.

After the blanks are cut or slit, the dies are placed on the fingers, the tailstock spindle is moved, and the rolls draw the blank into the die. The completed work is driven out by means of a ⅛-in. thick circular plate, a trifle smaller in diameter than the shell itself, the center of which is riveted to a bar that passes through the hollow headstock spindle. Either a weight or a cross handle can be used to give force to the knockout blow. The shell comes out on the forming rolls as the tail spindle is withdrawn.—S. C. H.

Keeping Oilstones in Condition

FOR cleaning an oilstone that is glazed or gummy, use ammonia or gasoline on a piece of cotton waste. If the stone is in very bad condition, scour it with emery powder or sandpaper.

To true up the surface, rub it on a flat piece of cast iron with loose emery and water.—S. J.

SHOWS THE WAY FOR ⅛ OF A MILE

YOU need this reliable electric lantern around the home, in the garage, for your workshop. And if you shoot or camp you will find this lantern essential.
This super lantern throws *a beam of light three city blocks.* The adjustable focus screw enables you to obtain all degrees of light from a strongly concentrated beam to a broadly diffused light. The sturdy aluminum case and soundly made connections make it impervious to weather and hard knocks.

To find anything on the high shelf—for use in the cellar—**under your automobile**—and for scores of other purposes you will find the ABLETT ELECTRIC LANTERN indispensable.

Operates on two ordinary dry cells, giving it exceptionally long life.

This lantern is made absolutely waterproof, moistureproof and gasproof; and it will last a lifetime. Order one today.
Complete with batteries for.....**$8.50**
Less batteries..... **7.50**

CHARLES R. ABLETT CO.
LAMP SPECIALISTS
199-201 Fulton St. New York, N. Y.

Deaf Can Hear Says Science

New Invention Aids Thousands

Here's good news for all who suffer from deafness. The Dictograph Products Corporation announces the perfection of a remarkable device which has enabled thousands of deaf persons to hear as well as ever. The makers of this wonderful device say it is too much to expect you to believe this so they are going to give you a chance to try it at home. They offer to send it by prepaid parcel post on a ten-day free trial. They do not send it C. O. D.—they require no deposit—there is no obligation.

They send it entirely at their own expense and risk. They are making this extraordinary offer well knowing that the magic of this little instrument will so amaze and delight the user that the chances of its being returned are very slight. Thousands have already accepted this offer and report most gratifying results.

There's no longer any need that you should endure the mental and physical strain which comes from a constant effort to hear. Now you can mingle with your friends without that feeling of sensitiveness from which all deaf persons suffer. Now you can take your place in the social and business world to which your talents entitle you and from which your affliction has, in a measure, excluded you. Just send your name and address to The Dictograph Products Corporation, 1300-C Candler Building, New York, for descriptive literature and request blank.

You, Too, Can Play the
HAWAIIAN GUITAR
Just as the Natives Do—

Only Four Motions—Which You Master Quickly! You Play Real Music Your First Lesson!
No previous musical knowledge necessary—no boresome "scales" or "runs". Be popular—play "Peggy O'Neill" "Three o'Clock in the Morning" "Stumbling"—*any music!*

OUR METHOD SIMPLE AND POSITIVE
The course of 52 lessons, when completed, enables you to play any piece of music—*just as the natives do!*

FREE a beautiful Hawaiian Guitar, and all necessary picks, playing barand 52 pieces of music. Start at once to master this weirdly sweet music. Just write, on a post card: "Send particulars of your free Hawaiian Guitar Offer and 52 lessons." And mail today.

First Hawaiian Conservatory of Music, Inc. - - New York City
Desk 46, 233 B'way, (Woolworth Bldg.)

DRIVE This Beautiful RACEABOUT INSTEAD OF YOUR OLD FORD

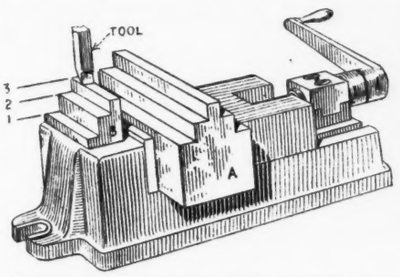
Fiat or Bullet Nose Radiator. Choice of four colors. Send for complete Catalog of Auto Bodies, Accessories and Speed Power Equipment. Direct from factory.

AMERICAN TOP AND BODY CO., Lee St., Delphi, Ind.

BETTER SHOP METHODS

Step Block Serves as Gage for Planing Duplicate Pieces

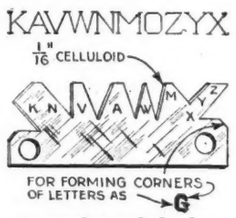
TO SAVE time in shaping a number of pieces, shown at *A*, I prepared a gage block, *B*, which was fastened to the top of the vise. Each surface, 1, 2, and 3, represented a height corresponding to a finished surface of the work, so that I could set my tool without taking time to make measurements.—J. M.



The fixed gage prevents errors and insures uniformity in planing and shaping

Celluloid Templet Saves Time in Lettering Drawings

WHEN the titles of drawings have to be drawn carefully in a strictly mechanical style, considerable time can be saved by using a simple templet cut from 1/16-in. celluloid.

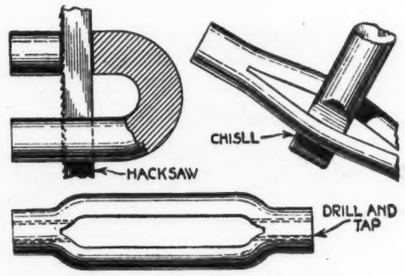


A templet and the letters made with it

The templet provides the correct angle for the various letters and insures neatness and uniformity of style. It serves for drawing letters from 3/8 in. high up to the limits of its capacity. Two guide lines are drawn for each line of lettering, and the base of the templet is rested on the top edge of the T-square and slid along like a triangle.—F. S. V.

Shopmade Turnbuckle Saves Time in Emergency Repairs

WHEN a turnbuckle has to be replaced quickly and one of the necessary size is not at hand, it is possible to make a simple and satisfactory substitute from cold rolled steel. A piece of the requisite length and diameter is doubled over after heating and slotted with a hacksaw, as shown. After it has been reheated and straightened, the slot is widened to its extremity with a cold chisel and the ends are tapped with right- and left-hand threads.—G. A. LUERS.



Three steps in making a substitute for a stock turnbuckle

This busy Corona store is located at 72 East Randolph St., in the heart of the Loop district, Chicago

See the New Corona first!

BEFORE you buy your portable typewriter, step into a Corona Store and see how many points of superiority the New Corona has over any previous type of portable.

Speed: The Standard Portable Keyboard, with right and left shift keys, cannot be surpassed for simplicity and swiftness of operation. Just compare it with the more complicated keyboards which have preceded it.

Convenience: Everything you would expect in a large machine, even to the automatic ribbon reverse, the two color ribbon, the extra wide carriage (10 inch), and the standard front-stroke type bar. In Corona you have a machine whose writing is completely visible—from the first word to the last. **Foreign language or technical keyboards at no extra cost.**

Strength: Corona is built to stand rough usage—and while Coronas have been dropped from every kind of conveyance, including an airplane, there is no record of a Corona frame ever having been broken. One reason for Corona's unusual sturdiness and wearing quality is the fact that it has fewer parts than other portables. Therefore its mechanism can be of heavier construction without sacrificing portability.

Reputation: Corona is the pioneer of portable typewriters. Among its owners and life-time friends are many of the most famous men and women of our time. More Coronas are in use today than *all other makes of portables combined.*

Look for "Corona" in your phone book, or write us for our new illustrated folder.

Price $50, with case. In Canada $69.

CORONA TYPEWRITER CO., INC.
112 Main St., Groton, N. Y. 129 W. 42nd St., New York
72 E. Randolph St., Chicago

Your wrist wasn't made with a Ratchet

That's why "YANKEE" Ratchet Screw-drivers *were* made—to save your muscles. No wearisome grip-and-let-go. Your first good grip need not be relaxed 'til screw is all the way home. It's like winding your watch.

"YANKEE" Ratchet Screw-drivers

No. 10 (Illustrated)—Specially tempered cast steel blades. 2, 3, 4, 5, 6, 8, 10 and 12 in. blades.

No. 11—Same as No. 10, except that ratchet shifter moves *across* barrel.

No. 15 (Illustrated)—Handy knurled thumb turn for starting small, wobbly screws. 2, 3, 4, 5, 6 and 8 in. blades.

Some other "Yankee" Tools

Spiral Screw-drivers — Ratchet Chain Drills
Ratchet Hand Drills — Automatic Push Drills
Ratchet Tap Wrenches — Bench Vises

Tool Book Free

Illustrates and describes all the ingenious "Yankee" Tools for saving time and labor. Write for it today.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

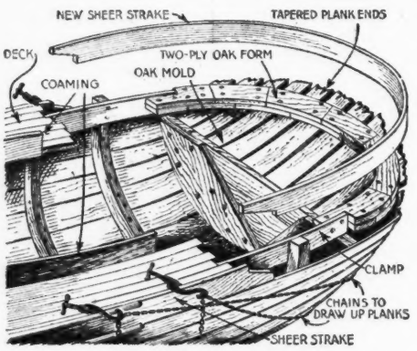
THE HOME WORKSHOP

New Motorboats from Old

by Capt. E. Armitage McCann

THIS is the first of three remarkable articles by Captain McCann, a nationally recognized expert on boating. He tells how to buy an old motorboat cheap and remodel it into a stanch and serviceable craft. Realizing that cost stands between the average man and a motorboat, we asked him to study the subject from all angles and work out ways in which the home worker can save himself hundreds of dollars on the cost of his boat. The result is this exceptionally practical and valuable series on repairing motorboats.—THE EDITOR.

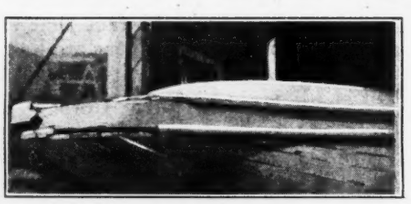
IF YOU cannot afford a new motorboat, why not buy some old boat that the owner does not think worth repairing and remodel it? Often the private owner who has plenty of money, or the "boats for hire" owner, to whom time is money, has a boat that can be obtained cheap because it is in disrepair, but you can perhaps make it seaworthy in your leisure time. The work will not only save money, but it will be interesting and entertaining, if gone at in the right way.



How the battered stern of a dilapidated motorboat can be drawn together and reconstructed

The skill necessary to build a boat from the keel up is not required, but you should have a good set of tools and be handy in using them. And, what is more important, you will need a large bump of the contriving faculty combined with perseverance and common sense. The materials will cost money, of course, but the expenditures will not have to be made all at once.

Old boats are to be found along any waterfront, in sheds, on slips, or just lying neglected out in the open. When the owner is discovered—sometimes quite a job—these may be had surprisingly cheap, often for from $50 to $100 without a motor. So far as the motor is concerned, if you are not familiar with them, it is advisable before buying to obtain the opinion of some one who thoroughly understands them, preferably a professional boatman.

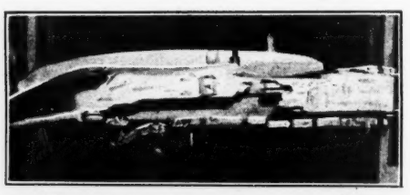


Having found a likely looking craft, you will have to decide if she is fit for repairing. It does not matter so much if she has a plank or so stove in, if her cabin is falling down, or the paint peeling off. What we have to try for is the soundness of the wood; to look for places worm eaten or suffering from wet or dry rot, or where putty has been substituted for good wood.

The places that go first are where the planks join the stem, stern, or keel, so here, with the big blade of our pocket-knife, we will scrape off some of the paint, and dig in the small blade to test for rottenness. If the keel is in very bad condition, the whole boat must be rejected, because to replace that would be nearly as hard as building a whole boat; but if it is bad only in places and then not too bad, we may be able to cut out the rotting or worm-eaten parts and replace with new wood.

The garboard strake or the plank joined to it is also frequently rotten and is the most difficult of the planks to replace, but it can be done. It may possibly be patched with a strengthening piece screwed to the inside. Sometimes a small bad place, such as might be caused by running on a rock, can be repaired with a patch of thin sheet lead, with plenty of paint under it.

We must see if the stem is sound, as that also is difficult to replace, and if the planks are still fastened well to it. It is possible to reinforce the fastenings here by shaping a piece of oak so that it will make a new face from the edge of the stem to 1 in. or so over the plank edges. If done neatly, this will detract little from the appearance and nothing from the speed, but will bind the edges of the planks firmly in position. All should be well cleaned underneath and a strip of thick tarred paper placed between the old and new.



Although the stern shown in these photos looks bad, it can be renovated successfully by the amateur boat builder

The sternpost and propeller shaft bushings must be examined, as this is another vulnerable part, where everything must be sound and rigid. Not much tinkering can be done on the outside here, but quite a lot of reinforcement can be accomplished with oak blocks on the inside.

Have a look where the ribs or frames are

fastened to the keel; if they are good here, they will be good elsewhere as far as rottenness goes, but watch for split ribs or others that may have been broken by accident. If only a few are bad or split, they can be replaced, or, as this is inclined to shake the boat and leave holes in the planks, it is better to put the new ones alongside the old, leaving the latter there.

As for the shape to choose, one has to be guided by what one can get and the purpose for which it is to be used. If large parties for short cruises are anticipated, a roomy boat will be wanted, with plenty of cabin space. If speed is desired, the lines must be finer in bow and stern. The "compromise" or the V-shaped sterns are considered to be good both for behavior in a seaway and for speed. The fan shaped stern, as in the photograph, though good in a heavy sea, is inclined to drag and take from the speed.

Repairing the Stern

The problem of repairing will, of course, be different for every boat, but yet there will be many points of similarity. It is hoped that not all of the repairs given here will be necessary, but some of them probably will, and, of course, any of them will apply to a good boat that has met with an accident.

The boat selected has, as will be seen, met with very rough usage in the stern and her counter is in pieces, but the wood, except where broken and along the very edge, is sound. Now 1 ft. or 18 in. might be sawn right off the counter and a flat stern substituted, but this would be unsightly, as she is not built for a flat stern. We can, however, shorten up the stern about 6 in. without spoiling her lines.

First of all we will lift the coaming (rim) of the well, then raise the deck in the stern, some of which will have to be renewed anyhow. Take off the chafing moldings and cut back sheer strake (top plank) some

(*Continued on page 100*)

Coupon for Ordering Blueprints

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York

GENTLEMEN:
Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

No.	*Title*	*Price*	
1.	Sewing Table	25c	☐
2.	Smoking Cabinet	25c	☐
3.	Book Trough End Table	25c	☐
4.	30-ft. Monoplane Glider	50c	☐
5.	Kitchen Cabinet	25c	☐
6.	V. T. Radio Receiving Set	25c	☐
8.	Shaving Cabinet	25c	☐
9.	Arbor with Gate and Seats	25c	☐
10.	Porch Swing	25c	☐
11.	Bench and Tilt-Top Table	25c	☐
12.	Electric Washing Machine	25c	☐
13.	Tea Wagon	25c	☐
14.	Toy Train, Horse, and House	25c	☐
15.	Home Workshop Bench	25c	☐
16.	Inlaid Radio Cabinet	25c	☐
17.	Cedar and Mahogany Chest	25c	☐
18.	Telephone Table and Stool	25c	☐
19.	Grandfather's Clock	25c	☐
20.	Flat Top Desk	25c	☐
21.	Colonial Writing Desk	25c	☐
22.	Girl's Cabinet and Desk	25c	☐
23.	Pergola Garage	25c	☐

Name.....
(Please print)

Street.....

City and State.....

Mrs. Gowen, in owner's cabin, writing up the log of the cruise on her Remington Portable

The famous "Speejacks," three times reported lost, now safe at home after 16 months' voyage

Around the world with the "Speejacks"

THE 35,000-mile cruise of this little 98-foot motor yacht was a thrilling exploit, replete with courage, daring, hardship and adventure.

Lonely tropical islands of the South Seas, off the routes of trade—the East Indies, the Red Sea, the Mediterranean—the empty miles of the Atlantic, were covered by Commodore Gowen and his wife in a wonderful voyage of more than a year.

The log of this amazing cruise was written, from start to finish, by Mrs. Gowen, on a

Remington Portable Typewriter

Here is Mrs. Gowen's own story of how this sturdy machine performed:

"One of the most useful necessities of our equipment for the 'Speejacks' was the Remington Portable Typewriter we purchased before leaving America. It stood the inclement weather, the torrid heat of the tropics and the frequent douchings of salt water without loss of efficiency.

"I don't suppose that any typewriter in existence ever had harder wear or went through a more stormy period than did this typewriter.

"It is in as good condition today as the day we bought it. I am still using my Remington with a great appreciation of its endurance and efficiency."

The Remington Portable has the Standard four-row Keyboard. Fits in a case only four inches high. For sale by over 2500 dealers and Remington Branches everywhere. Write to us for "Your Ever Handy Helper." Adddress Dept. 67.

Easy payment terms if desired

Remington Typewriter Company
374 Broadway, New York

A good typewriter deserves a good ribbon. Use Paragon Ribbons on Remington Portable Typewriters. Made and sold by us.

They know why they prefer "B.V.D."

THE cool, keen level-headed men who follow the world of sport and lead the world in comfort—they know the Unvarying Quality, Long Wear and Famous Fit of "B.V.D." Underwear, and make it a part of their formula for getting the most out of life.

From raw material to finished product we practice ceaseless care so that every "B.V.D." garment is of the quality that has brought world-wide preference for our product.

The cool, durable nainsook of "B.V.D." is woven in our own mills from selected cotton and finished in our bleachery.

In our factories vigilant inspection guards every process of skillful cutting, sturdy stitching, well sewn buttons and accurate finish.

There is only one "B.V.D." Underwear
It is always identified by this Red Woven Label

Union Suits (Pat. U. S. A.) Men's $1.50 and upward the suit Youths' 85c the suit

MADE FOR THE B.V.D. BEST RETAIL TRADE

Undershirts and Drawers 85c and upward the garment

The B.V.D. COMPANY, Inc., New York
Sole Makers of "B.V.D." Underwear

© 1923 The B.V.D. Co., Inc.

NEXT TO MYSELF I LIKE "B.V.D." BEST

W. L. DOUGLAS

NAME AND PORTRAIT is the best known shoe Trade Mark in the world. It stands for the highest standard of quality, style and workmanship at the lowest possible cost.

W. L. DOUGLAS shoes are actually demanded year after year by more people than any other shoe in the world

BECAUSE W. L. Douglas for forty-six years has been making surpassingly good shoes. The smart styles are the leaders everywhere. When you need shoes and are looking for the best shoes for your money examine W. L. Douglas $7.00 and $8.00 shoes. They are exceptionally good value for the price. Wear them and save money.

$5. $6. $7. $8. & $9. SHOES FOR MEN & WOMEN

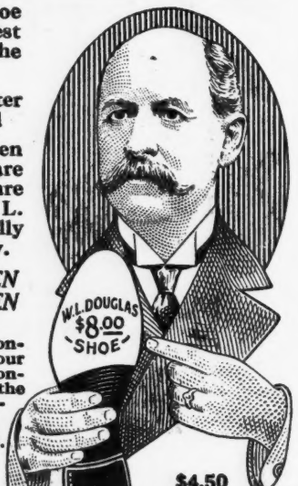
NO MATTER WHERE YOU LIVE

shoe dealers can supply you with W. L. Douglas shoes. If not convenient to call at one of our 116 stores in the large cities, ask your shoe dealer for W. L. Douglas shoes. Protection against unreasonable profits is guaranteed by the name and price stamped on the sole of every pair before the shoes leave the factory. Refuse substitutes. The prices are the same everywhere.

IF NOT FOR SALE IN YOUR VICINITY WRITE FOR CATALOG.

TO MERCHANTS: If no dealer in your town handles W. L. Douglas shoes, write today for exclusive rights to handle this quick-selling, quick turn-over line.

W. L. Douglas
President
W. L. Douglas Shoe Co.
124 Spark Street, Brockton, Mass.



$4.50 & $5.00 BOYS' SHOES

THE HOME WORKSHOP

New Motorboats from Old

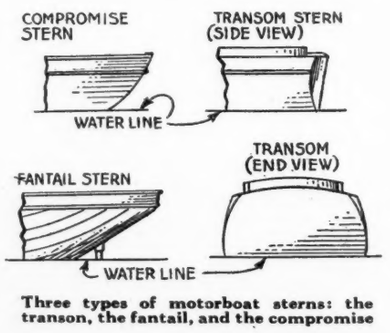
(*Continued from page 99*)

3 ft. or more from the stern. Now that we can get at the inside, we shall carefully loosen up all the planks that run into the stern and lift out the one or two ribs that will be free and also carefully remove the oak timbering under the deck to which the planks were nailed, working back if possible to former joints.

What we want to do now is to shorten the stern a few inches. This will bring the ends of the planks higher, so that when they are sawn off level with the deck, we shall have sound wood for nailing. To do this, we shall have to shave each plank some way back, making long open Vs between each. We shall then get a couple of chain clamps, fasten them well forward as high as possible, with the chains passing round the stern, and screw up until the planks come together again.

Previously to this, however, any planks that are very badly broken, like the one on each quarter, will have to be taken out to the old butt, or to a newly made joint where it is farthest from another. The new planks are cut from the old, which are used as a pattern, not forgetting that the after end will be narrower than before. The planks amidships that contain the rudder trunk and join the sternpost will possibly need renewing; it is worth the trouble to do so if they are at all shaky at the lower end.

Having got the planks in position, so that the bad ends can be cut away, make a shape of oak to fit snugly inside them at the level of the under side of the top strake.



Three types of motorboat sterns: the transon, the fantail, and the compromise

Join this up firmly to the old clamp; then make another shape to take the place of the ribs removed. Have it solid and arranged to meet the inner side of the planks when upright about 1 ft. from the stern and to screw on to the under side of the horizontal shape. These shapes will be like templets, only very solid, say of 1½-in. oak, or, better, two thicknesses of 1-in. oak screwed together with the grain crossing. To these pieces fasten the planks in their new position, using galvanized nails, brass screws, or, for preference, copper rivets clinched on the inside over burrs.

A new sheer strake will now have to be cut, bent, and fitted. It should be the same thickness as the old. For this, and possibly for any new planks, a steam box will be necessary and will be described later. This being in position, saw the edges of the planks to it; also saw them off vertically in the same line as its outer edge.

Put in a beam or cross piece to hold the deck, nailing it to the shape and the sheer strake. Relay the deck, cutting it to the

(*Continued on page 101*)

THE HOME WORKSHOP

New Motorboats from Old

(*Continued from page 100*)

same level as the side planks; remove the clamps, put on new moldings, and you should have a nice, new, strong stern.

Next month we shall examine the bows and sides and, following that, the deck, cabin, and fittings.

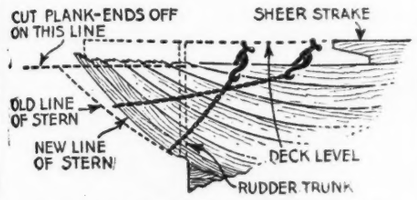


Diagram showing how an old stern may be pulled together, trimmed, and patched up

Cheap Garage Made of Porch Screens and Cement Mortar

WHAT is possible in the construction of a cheap garage is shown by the accompanying illustration. Although this garage is 10 by 18 ft., the walls are merely porch screens that had gone into disuse.

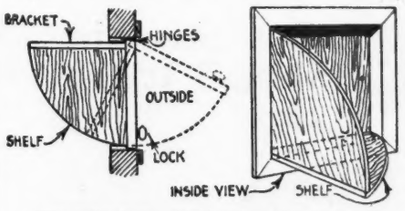
Screens covered with cement mortar

Between the brace pieces of the screens, other pieces are fastened to keep the frames solid, and the frames are nailed to posts. The whole is then plastered over with a rich cement mortar so as to make a perfectly hard and unyielding wall. The result is a garage that, in spite of its lightness and cheapness, will last for years.—ROBERT PAGE LINCOLN.

Answering the Telephone from Outside the House

ANY one whose work is largely outside the house can save many steps by installing this simple panel telephone shelf.

Cut an 18-in. square opening in the outside wall of the building and frame it to receive a hinged door, opening outward. Make the door of heavy stock and provide a key lock or a simple combination lock, then cut out a shelf in the form of a quarter



The telephone shelf swings in and out

circle with a radius just small enough so that it will swing through the opening without touching the sides. Nail this near the inside bottom edge of the door and support it with a vertical wooden bracket of similar pattern and size.

The phone is placed on the shelf and is always accessible to those in the house, but if the owner wishes to answer it from outside, he merely opens the door by the lock and swings the shelf and phone outdoors.—L. B. ROBBINS.

CA$H for PRACTICAL IDEA$

together with wide-open Opportunity to alert minds in one of America's Largest and Most Substantial Industries

Pressed Metal is one of the greatest blessings that American mechanical genius has given the world.

Its range of usefulness, economy and convenience to every man, woman and child, is so great that it has hardly began to blaze the trail of its possibilities.

The Pressed Metal Industry today totals about $20,000,000.00 a year. If it could realize its full field of utility by a wider public knowledge of its value as a *public service*, it would crowd ten times that annual output.

Shoe-eyelets are Pressed Metal. Modern railway cars are Pressed Metal. Stew-pans, auto-bodies, telephone instruments and door-knobs are mostly Pressed Metal. You begin to get an idea of the range of use. Don't you?

Pressed Metal is *anything* that can be produced by *stamping* from sheets of steel, brass, aluminum, copper or any other useful metal. Take the brakes off your brain and

SELL US AN IDEA

of some new and practical way to utilize Pressed Metal. The Pressed Metal Trade Extension Council will promptly *pay* for every acceptable suggestion approved by our Engineering Advisory Board.

Please do not trifle with this, as our purpose is serious and constructive and in the public interest. The membership of the undersigned Council includes many of the largest manufacturing corporations in the United States and their purpose and plans are broad and businesslike.

The Plan briefly outlined above should, at an early date, and continuously thereafter, release the *hidden genius* and *practical intelligence* now bottled up in thousands of ambitious workers.

After you receive the Pressed Metal booklet, *which, of course, you will write for immediately,* you will follow this schedule:

1st: Get your inspiration, either by a flash or by deliberate study. 2nd: Formulate it so that it is perfectly plain. Sketch it if it will help any. 3rd: Send it *with no money and no references,* to the Pressed Metal Trade Extension Council, as undersigned, and await the decision of the Pressed Metal Engineering Advisory Board. If you—but *our space is used up*—so you will have to get the rest of it out of the Pressed Metal Booklet.

Write Right Away for the Free

BOOKLET — PRESSED METAL TEC — BOOKLET

It contains full explanation of what we want from you and how you can get it to *us* in the way most profitable to *you.* It tells you

HOW TO CAPITALIZE YOUR MECHANICAL TALENT

or inventive genius—or maybe just your "good old common-sense." It tells all the conditions and the amounts to be paid for the successful ideas, and also how to protect yourself against misappropriation of your creative thoughts by others. WRITE TODAY. (A post card will do, but, please, make it easily legible so it can be properly filed and acknowledged.) Address

DEPT. B **PRESSED METAL TRADE EXTENSION COUNCIL**
27 QUINCY STREET, CHICAGO

$25.00 in Prizes

See page 6 in front of book for full details

COMBINATION MACHINE $11.75

Complete machine with hard wood base less attachments or saw, no light constructed affair, perfectly machined for continuous heavy duty, absolute alignment—most perfect lubrication, made of high grade steel, cast iron, bronze and aluminum. Use 1-4 to 2 H. P. motor, takes 8 or 10 inch saw, cuts or rips three-inch stock, attachments for cutting bakelite, type metal, brass, etc., GRINDING - DRILLING - BUFFING - SANDING. Only modern method of manufacture enables us to make such startling introductory offer on first 1000 machines sold. Fully guaranteed. Circular upon request.
VENTOM MFG. CO., Dept. A, 722 Wall St., Wichita Falls, Texas.

THE HANDIEST TOOL in the WORLD

OLSON Magazine Screw Driver

OLSON Large enough to hang a door. Small enough to fix a bell. Three blades, one awl, guaranteed. Fits any common screw and makes holes. Ask your hardware store or send $1.25, prepaid.

OLSON MFG. CO.
52 Commercial St., Worcester, Mass.

BOYS!!

LEARN HOW TO PLAY ANY TUNE IN ONE AFTERNOON

FREE Complete instructions for making real music with a Hohner Harmonica (Mouth Organ) sent free to any American Boy. First learn the scale—"do, re, me, fa" etc. Then try "Home Sweet Home." Diagrams and full explanations show you how you can do this easily with a

HOHNER HARMONICA

After you've done this you can play any tune you can whistle—with chords and full accompaniment. Harmonica is most popular music on the radio. Biggest hit of the year in New York Orchestras. Be the first boy in your neighborhood to play a harmonica *well.* Astonish your folks and friends. Be sure to ask at the music goods store, general store, stationery or drug store in your town for a Hohner Harmonica—50c and up. Write us this minute and say "Send me Hohner Harmonica Instructions" and give your name and address. Write now, to:—

Wesley Barry, Warner Bros. star is a Hohner fan.

Send now for free instructions

M. HOHNER, Dept. 22.116 E. 16th St., New York City

Get a Hohner at Your Local Store

THE HOME WORKSHOP

Getting Manpower to Jibe with Horsepower

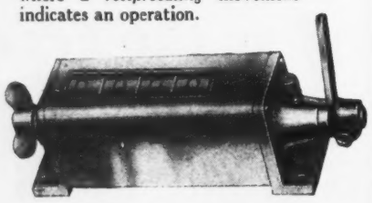
On the *mechanical* end of your machine, a certain amount of horsepower will make things move to your satisfaction.

In the case of the machine *OPERATOR*, it's the power of *interest* and *concentration* that moves to action and gets output.

When the eye of the operator is on his production-record, his *mind* is on running up that record! —with a result that registers most gratifyingly on your

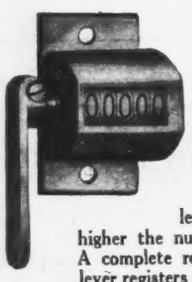
Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-Back *Revolution* Counter of similar model, $10.00 (list).

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



Everything you could ask in a counting device is shown in the new 80-page Veeder booklet. Ask for this wonderfully complete counter booklet.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Attractive Pergola Garage

(*Continued from page 79*)

himself; and if he is going to choose between making the sash and frames or the doors, it is better to make the doors. The doors, if homemade, should be well braced either with strap irons or sheathing nailed diagonally on the back.

The modern method of providing a foundation for a small garage, such as this, is to lay a substantial concrete floor as large as the outside dimensions of the garage and place heavy anchor bolts near the corners and the doorposts. The sills are then bored to suit the bolts, put in place, and bolted fast.

Before starting the floor, provision should be made for draining it. The best method is to have a plumber run a drainpipe to the house drain, but if it is desired to avoid this expense, a deep hole can be dug in the rear of the garage or at one side, filled with stones, and connected by means of a round tile pipe drain to the garage. The downspout from the roof also may be drained into this hole. Usually this is sufficient provision, as a relatively small quantity of water is used in the garage, and the roof area is trifling.

Water should be piped to the garage, if possible, in the usual way, by digging a trench from the house. This work should be done before laying the floor.

How to lay the floor is described in detail in an article on cement construction on another page. It should pitch from the sides toward the center, where a common iron drain and strainer are placed. The entire floor can slant, but it is often best to have the floor level around the sides and ends and pitched only in the center, where the car stands. The floor should be a little higher than the grade level and the earth banked up on three sides.

Other methods of providing a foundation may be used. One is to build a concrete foundation wall 8 or 10 in. thick and 3 ft. deep; another is to provide concrete piers. Creosoted wooden posts will serve and on good hard ground the garage can be supported on heavy sleepers. The latter methods are frequently used in connection with a wooden or dirt floor.

How the Frame Is Built

The sills are either 4 by 4s or 2 by 4s doubled. The latter are easiest to handle since they are naturally adapted to the half lapped joints at the corners. The corner posts are 2 by 4s doubled and the studs are 2 by 4s placed either 16 or 24 in. from center to center. The studs are cut so as to provide for a fall of 6 or 9 in. from front to back. A single or double 2 by 4 is spiked to the top of the studs to form a plate. The rafters, which are 2 by 6, are covered with the ⅞ by 6 in. tongue-and-grooved ceiling. The 2 by 4s will cut with the least waste if they are obtained in 18-ft. lengths.

The standard construction, it should be noted, is to place the 2 by 4s on 16-in. centers and that is frequently required by building codes. If it is not required, the construction with 24-in. centers will be strong enough. However, if beveled siding is used, 16-in. studs are preferable, because the siding needs support at fairly close intervals.

It is really easier for the amateur to use a novelty siding, as it is stiffer and more

(*Continued on page 103*)

ATKINS METAL CUTTING SAWS

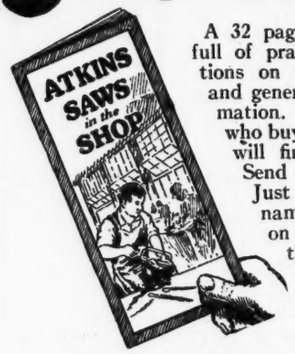
End Hack Saw Blade Breakage

WITH Atkins "Non-Breakable" Hack Saw Blades you can not only eliminate practically all losses due to blade breakage, but also do metal cutting faster and easier.

These blades give remarkable cutting results. Made of selected steel, they are hardened and tempered by an exclusive gas and oil process which makes the cutting edge extremely hard and the body of the blade unusually tough and flexible. That's why they out-cut and out-last other blades. Prove it for yourself. Send us ten cents and tell us what metal you cut and we'll send a sample blade. You'll say it's the best you ever used.

No matter what wood or metal-cutting you do, there are Atkins' Saws to save you time, labor and money. Ask for our free booklets on the saws you're interested in.

Get "Saws in the Shop." It's FREE



A 32 page book that's full of practical suggestions on metal-cutting, and general shop information. Every man who buys or uses saws will find it helpful. Send for it NOW. Just write your name and address on the margin of this page and mail it to us.

Do It Now

E. C. ATKINS & CO., Inc.,
Dept. D-20, INDIANAPOLIS, IND.,
Makers of Silver Steel Saws and Tools

THE HOME WORKSHOP

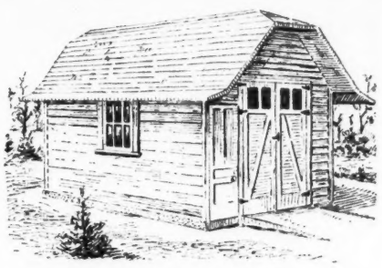
Attractive Pergola Garage

(*Continued from page 102*)

easily handled. Another advantage is that it permits a considerably simplified corner construction to be used. Instead of butting the siding carefully and accurately against corner strips, the siding is carried to the corners and the strips are placed on top, as illustrated on page 79. Beveled siding should lap about 7/8 in.; in other words, siding that is 5½ in. wide shows 4½ or 4⅝ in. to the weather.

A sheathing of rough 1 by 8 or 10 in. boards laid under the siding will make the garage warmer and more durable, or rosin sized building paper or building felt can be tacked to the studs under the siding.

Although double windows are shown on three sides of the garage, one or more pairs



Where a pitched roof is preferred or required by the building code, this style is neat and simple to build

can be omitted; in fact, the rear windows will be sufficient. It is desirable, however, to have plenty of light, and a good size double-hung window over the bench is an improvement. The addition of a 2 ft. 8 in. by 6 ft. 8 in. door is also often desirable, especially if the garage is used much as a workshop.

The principal objection to this type of garage is that it is not fireproof. The danger of fire is somewhat minimized, however, if only the owner himself uses the garage. He is apt to take all reasonable precautions against fire, especially when he has built the garage himself. In spite of the fire hazard connected with a frame garage, it is undoubtedly the easiest and cheapest for the average home worker to construct.

An improvement possible for any one who has had experience in plastering is to cover the building with stucco. This simply involves nailing metal lath to the studs and covering them with stucco. If the inside also is covered with metal lath and Portland cement or gypsum plaster, the garage will be fire resistant to a considerable degree.

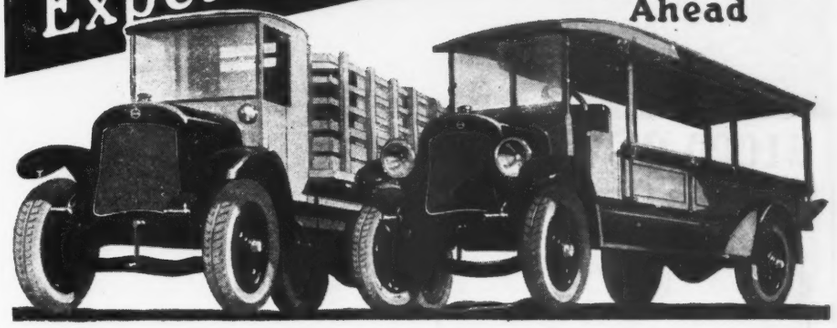
If plans must be filed with the Building Department, the home worker can draw them up very simply by copying the plan, front and side elevations on page 77. This drawing should either be drawn or traced on tracing paper or tracing cloth, so that several blueprint copies can be made.

Or, if preferred, you can obtain as many copies as are necessary of POPULAR SCIENCE MONTHLY'S Home Workshop Blueprint No. 23, and fill in your name and address in the space especially provided for it. This blueprint gives fully dimensioned constructional details of the garage, a complete bill of materials, showing exactly what sizes and quantities of lumber to buy, and additional details of

(*Continued on page 104*)

Be A Transportation Expert—The New Calling

A call to Men who look Ahead



Motor Truck Transportation—already a big and profitable business—is getting better every day. Modern business demands a speed of delivery that only motor trucks can furnish.

Every community requires a Ruggles transportation expert—a trained man who can advise business men on their haulage problems.

Men in hundreds of cities who have joined the Ruggles organization are making large incomes. Many of them started in a very small way. There is opportunity for you in your home town or wherever you wish to locate.

This is an opportunity for the man who wants to get into business for himself—who is honest and ambitious—who has the sand to stick to a proposition.

Such a man is offered the franchise for the World's Greatest Truck Value, a line of quality trucks selling as low as $795, trucks with a record of success and a lineage of experienced men behind them.

Another Opportunity—If the Ruggles franchise is closed in your town you can make big money by operating an express or bus line with one or more Ruggles Trucks. We'll gladly send you full instructions for starting a successful bus or express business on small capital.

Write us in strictest confidence, stating which proposition interests you

RUGGLES MOTOR TRUCK COMPANY, *Saginaw, Michigan*
Canadian Factory: Ruggles Motor Truck Co., Ltd., London, Ont.

RUGGLES

The World's Greatest Truck Value

SEND FOR THE INTERNATIONAL CATALOG

Our net price list. Full line of auto bodies and accessories for Fords at *Wholesale Prices*. Save big money on bodies by buying Direct from Factory.

FOR FORD—Prices from $27.85 up. Factory to consumer direct—Pay only One Profit
INTERNATIONAL BODY WORKS, 914 W. Ohio St., Dept. 8, Chicago, Ill.

CLASS PINS

FREE CATALOG Give name of school or club and number in class

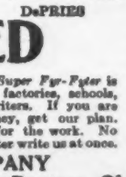
Either pin illustrated made with any 3 letters and 2 figures, one or two colors enamel. Silver plate, 20¢ ea., $2.00 doz. Sterling silver, 40¢ ea., $4.00 doz. Write for catalog of sterling and solid gold pins and rings.

Bastian Bros. Co. 450 Bastian Bldg., Rochester, N.Y.

"I have averaged $7000

Per Year for Three Years—Have Made Over $90 PROFIT in One Day"

That is the statement of Frank DePries, one of our live-wire representatives. Keeton of Mississippi made $252 on his first sale. Vickers of Alabama made $118 in one week. Conant quit a $6,000 job to come with us.



DePRIES

Ford Auto FREE!

We have a plan whereby our active workers can get a Ford without cost, in addition to their big cash earnings. Get the plan—quick!

AGENTS WANTED

We need more men like these, because the demand for our *Super Fyr-Fyter* is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY
1714 Fyr-Fyter Bldg., Dayton, Ohio

$1000 REWARD

For the Capture of This Man

CONVICT 6138, escaped from the State Penitentiary; Name, Charles Condray; Age 37; Height, 5 ft. 8 in. Weight 141 pounds; Hair, light brown; Eyes, gray.

Easy enough to identify him from his photograph and this description, you may say—but, Condray took the name of "Brown", dyed his hair, darkened his skin, grew a mustache, put on weight and walked with a stoop.

Yet, he was captured and identified so positively that he knew the game was up and returned to the penitentiary without extradition. How was it accomplished? Easy enough for the Finger Print Expert. They are the specialists, the leaders, the *cream* of detectives. Every day's paper tells their wonderful exploits in solving mysterious crimes and convicting dangerous criminals.

More Trained Men Needed

The demand for trained men by governments, states, cities, detective agencies, corporations, and private bureaus is becoming greater every day. Here is a real opportunity for YOU. Can you imagine a more fascinating line of work than this? Often life and death depend on finger print evidence—and big rewards go to the expert. Many experts earn regularly from $3,000 to $10,000 per year.

Learn at Home in Spare Time

And now you can learn the secrets of this science at home in your spare time. Any man with common school education and average ability can become a Finger Print Detective in surprisingly short time.

Free Course in Secret Service

For a limited time we are making a special offer of a *Professional Finger Print Outfit, absolutely Free,* and *Free Course in Secret Service Intelligence.* Mastery of these two kindred professions will open a brilliant career for you.

Send for Free Booklet

Write quickly for fully illustrated free book on Finger Prints which explains this wonderful training in detail. Don't wait until this offer has expired—mail the coupon now. You may never see this announcement again! You assume no obligation—you have everything to gain and nothing to lose. Write at once—address

University of Applied Science
Dept. 13-65 1920 Sunnyside Ave., Chicago, Ill.

UNIVERSITY OF APPLIED SCIENCE
Dept. 13-65 1920 Sunnyside Ave., Chicago, Ill.

Gentlemen:—Without any obligation whatever, send me your new, fully illustrated, FREE book on Finger Prints and your offer of a FREE course in Secret Service Intelligence and the Free Professional Finger Print Outfit.

Name.....

Address.....

Town .....*State*.....

Attractive Pergola Garage

(*Continued from page 103*)

a simple construction for the doors, in case you wish to make them yourself.

The finished garage should be primed, after the knots are shellacked, with a priming coat of paint of the desired color or colors. The nail holes and any cracks should then be well puttied and one or two finishing coats of paint put on.

Be particularly careful to brush the paint on well so as to insure both a good looking and a permanent job. Painting is hard work and the amateur has a constant tendency to smear the paint on quickly and thickly without working it well into the wood. The inside should be given several coats of fire-resisting paint, if possible.

One ingenious home worker painted his garage and all the wicker porch furniture, with a comparatively inexpensive paint sprayer operated by air from the air compressor on his car. Incidentally, he refinished his car in the same way and renovated all the screens for the house with a screen paint. In connection with a foot pump, he used the same sprayer for refinishing the radiators through the house, making a much quicker and better job than could be done by a brush, because there were no runs or laps.

Two other inexpensive garages with slanting roofs. That at the right is shingled throughout

A paint sprayer, even if it is of the simple foot-pump type that can be purchased for about $5, is a valuable addition to the staining, painting, and finishing equipment of any home workshop.

Returning to the garage, if you happen to be in a locality where the building restrictions forbid flat roofs, you cannot use a pergola design and a hip or gable roof should be substituted. Several of the accompanying sketches offer suggestions for this modification.

Various refinements can be incorporated at the time of building or added later, such as an outside storage tank underground with a pipe line to the garage, or a rear addition for a heating plant, and a concreted and drained repair pit with a sliding seat.

Suggestions for doing the necessary concrete work, including making the foundation, laying the floor, and building the roadway, are contained in an article on cement construction on page 112.

Phonograph Needle Scriber

AS A scriber for use in the home workshop, a steel phonograph needle held in a small pin vise or other holder, will give excellent service. It is better than an ordinary pocket scriber because after use the scriber has to be ground, whereas phonograph needles are cheap and can be thrown away when dull. A few kept in the toolchest will insure having a sharp point always on hand.—C. J. WATTERS.

The extra H.P. safe, fast motor

Safe rudder steering—no dangerous pivot turning—the safe family motor. Big, hot spark independent of cranking speed means instant start on *first quarter turn.* Full 3 H. P.—an extra H. P. over all other light motors, *by piston displacement.* That's the extra H. P. needed to give speed to seaworthy boats—to buck wind, waves and currents. The most powerful light weight motor—lightest motor per H. P.

Big Bearings—more than double the crankshaft, and connecting rod bearing surfaces of other light weight outboards. That means reliability and trouble-free service life. Vibrationless, safety-tilting, weedless, beautiful in design and finish.

Trust Ole Evinrude, the pioneer designer and manufacturer of outboard motors, to build his perfected twin "as light as right" at no sacrifice of power or bearings. Sold only under name Elto.

Elto Outboard and Inboard

3 H.P. Fast Light Twin
"As light as right"

Write for catalog that shows you how to judge motor values.

Dealers and Demonstrating Agents. No middlemen. Fine opportunity if your territory is still open. Write.

ELTO OUTBOARD MOTOR CO.
Dept. W. Manufacturer's Home Bldg.
Milwaukee, Wis.

Man—An Animal Invention

(*Continued from page 34*)

invention the great controlling telephone exchange of the human brain would never have been possible at all.

All these inventions—muscles, bones, a body lifted off the ground, warm blood, and the forced circulation of it—were made by animal ancestors that could not in any sense be called human. The dog, the tiger, even the very primitive kangaroo, possess these inventions as perfectly as we.

We come now to two inventions that are peculiarly human, which have determined more than anything else the preeminence of man in Nature. These are the invention of the erect posture and the modification of the two front feet into hands.

How Hands Were Developed

Both of these inventions were made long ago, when the creatures that were to be men were still living in the trees. It was tree living, the clinging to branches and sitting upright on them, that turned the backbone up on end. It was tree living, also, that developed the front foot into a grasping organ that at first learned to hold onto branches and presently to take hold of food and finally of tools.

Every stage in these two important developments can be traced in man's nearest animal ancestors, the group called primates, from the four-footed, handless lemurs, up to the manlike apes such as the gorilla, whose hands are almost human in form and use.

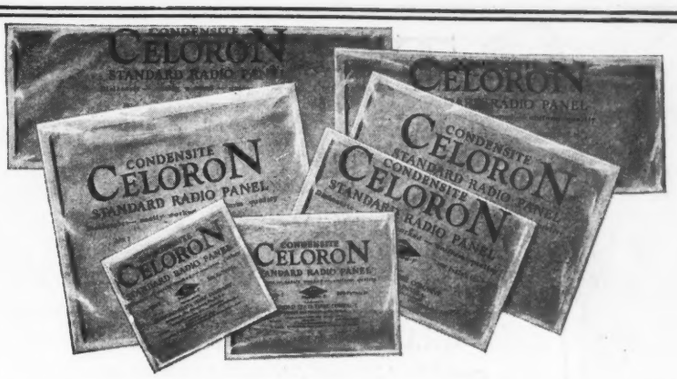
Active life in the trees was a great incentive to agility. It made necessary many bodily improvements; a sureness of grasp, the art of balancing the body, the accurate coordination of eye and muscle in leaping from branch to branch; all of which were prerequisite to upright walking on the ground. The human hand and the human foot are extremely ingenious organs, but both contain, as do scores of other parts of the body, unmistakable evidences that they were invented originally for a life of skipping about among the branches high above the ground.

Use of Brain Prolonged Life

And this tree life required, also, the development of corresponding improvements in the great central station of the nervous system—the brain. There had to be perfect coordination between every part of the body or else one fell and died. And so there came to be innumerable new connections between the nerve cells in the brain and outside it, new nerve centers for the relaying of messages, new automatic controls such as that necessary for balancing. There developed, also, great storage chambers where the records that we call memories could be accumulated and automatically thrown in or out of the thought circuit whenever they were needed, thousands of times, perhaps, in a single hour.

Thus our life in the trees forced us to build ourselves a brain. It forced us, also, into another invention that is peculiarly human, being shared only by our nearest relatives, the higher apes. This is the rangefinder eye. The two eyes of man are placed side by side in the front of his head. They can judge the distance from branch to branch or other distances. They give us a conception of solidity exactly as the two lenses of the rangefinder give to the

(*Continued on page 106*)



One of these panels fits *your* set

YESTERDAY you would have had to wait while the size was cut from sheet stock.

Today you can get the panel you need immediately. Celoron Radio Panels come in standard sizes, one of which will be right for any set you may build.

Each Celoron Panel is already cut and wrapped ready for you to take home. Full instructions for working and finishing are on the glassine paper around every panel.

The sizes meet the present day needs of set-builders. Your dealer will supply you with any of the following sizes:

1.—6x 7x⅛ 4.—7x18x3/16
2.—7x 9x⅛ 5.—9x14x3/16
3.—7x12x⅛ 6.—7x21x3/16
7.—12 x 14 x 3/16

Also comes in sheets and can be cut in special sizes when desired.

Condensite Celoron has high insulating qualities, high dielectric strength, and low dielectric losses. It is used by many of the leading manufacturers of radio equipment. It is easily machined and can be sawed, drilled, turned, or milled.

Send for free booklet

We have prepared an attractive booklet, "Tuning in on a New World," which tells more about Celoron and gives lists of leading broadcasting stations in the United States and Canada, symbols used in reading radio diagrams, and several highly efficient radio hook-ups. This booklet will be of use to every radio fan and will be sent to you free of charge upon your request. Write today.

Diamond State Fibre Company

BRIDGEPORT (near Philadelphia) **PENNSYLVANIA**

Offices in Principal Cities
In Canada: Diamond State Fibre Company of Canada, Limited, 245 Carlaw Avenue, Toronto

To radio dealers: Celoron Radio Panels cut in standard sizes offer an exceptional opportunity for quick sales and substantial profit. Write for special dealer price list showing standard assortments.

CONDENSITE
CELORON
STANDARD RADIO PANEL

$25.00 in Prizes

See page 6 in front of book for full details

Only $45.00 For This Job Complete

Save exorbitant freight rates and one-half original cost by buying Ford Speedster Bodies knocked down. Simple, complete instructions furnished, all parts cut to exact fit. Any one can assemble this job. Complete with hood, radiator shell, instrument board, upholstering, metal parts, wood parts, bolt screws, etc. Flat radiator shell furnished made up. Designed low with lack of wind resistance. Price set up $90. Further particulars on request.

Not Paper Patterns All Parts Complete

The Central Auto Supply Co. Exp. Dept. 122 Louisville, Ky.

HAIR GROWS!

When our **Vacuum Cap** is used a few minutes daily. Sent on 60 days' FREE trial at our expense. Stops falling hair and dandruff. Science combined with common sense. No drugs or electricty. A postal brings illustrated booklet.

Modern Vacuum Cap Co.
400 Barclay Denver, Colo.

PROFITABLE SPARE TIME WORK

BUILD YOUR OWN
GRANDFATHER'S CLOCK
WITH OUR HELP

We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends. Complete Works $5.00.

Others with Chimes at all prices. Ask for our attractive Free Catalogue

AMERICAN CHIME CLOCK CO., 1675 Ruffner St., Philadelphia, Pa.

The New Tool You Are Looking For

The Simore Lightning Change Magazine Screw Driver

3 Blades—Change them in 2 seconds

GRAVITY DOES THE TRICK

PRODUCES INSTANTLY THE DESIRED BLADE

Gravity produces the blade you want as you tip the handle as illustrated—a quarter turn of the knurled cap at the base of the blade locks the blade for use. When thru turn the cap again and the blade springs back into the magazine.

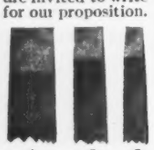
A turn of the end cap locks the three blades in the handle—you can't lose them—never in the way—always ready for use.

You need this in your Radio equipment.

You'll say it's handiest thing you ever saw. For the man or woman around the house it's just right. Mechanics, carpenters and cabinet makers won't be without it, once they see it. It is a brand new tool, the strongest of its size, and kind. Send for one today. Each tool guaranteed.

$1.80 Prepaid Parcel Post

Dealers and others are invited to write for our proposition.



1 2 3

There are three steel blades, each carefully ground to fit the screw slots.

Simon & Skidmore Mfg. Co.

110 E. 6th St., Santa Ana, Calif.

MAKERS OF THE SIMORE AUTOMATIC UNIVERSAL SQUARE

A turn of the fingers and the blade disappears instantly!

The Most Wonderful Radio Loud Speaker in the World

$28.50

The DICTOGRAND

With the Adjustable Air Gap

Overcomes the defects common to all other radio loud speakers—the harsh jarring sounds, the noises and overtones. It creates the illusion that the artists are in the very room with the listeners.

The DICTOGRAND RADIO LOUD SPEAKER is designed to operate on any vacuum tube receiving set, giving maximum results when two stages of amplification or more are used. Requires no extra batteries. You simply plug in—and listen.

The DICTOGRAND RADIO LOUD SPEAKER, like all Dictograph products, is guaranteed for a period of one year against all electrical or mechanical defects.

The Adjustable Air Gap

consists of an adjusting dial mounted in front of the cabinet, by means of which the distance between the magnetic poles and the diaphragm may be increased or decreased, thus varying the pull of the magnet on the diaphragm and permitting tuning up in complete harmony under all varying conditions of reception.

ASK YOUR DEALER TO DEMONSTRATE IT

The unusual demand upon our facilities has not enabled us to complete our distribution. If your dealer has not yet received his stock of **DICTOGRAND Radio Loud Speakers**, send to us direct.

THE DICTOGRAPH PRODUCTS CORPORATION

Dept. 1311, 220 West 42nd Street, New York City

Branches in All Principal Cities

Dealers Order through your jobber; or send to us direct for names of authorized distributors.

Man—An Animal Invention

(*Continued from page 105*)

gunner a measure of how far away he is from an enemy ship.

Consider the eyes of a rabbit. One is on each side. Neither of them can have, except very slightly, the same field of view as the other. The world of the rabbit is a one-eye world. His conception of what we mean by space and by solidity must be a very curious conception.

It is difficult to overestimate how much of our knowledge of the real world around us we owe to this circumstance that we can look at the same object with both of our eyes at once.

Merely an Outline Possible

This gives you the barest outline of the story of the animal inventions; a few of the many great inventions on which the wonderful edifice of the human body is built—muscles, bones, blood, a forced oxygen supply, a massive brain close packed with active nerve cells, a hand freed from the burden of body support, two eyes that see distance and know the world for three dimensions instead of two.

Many others we have perforce left out of the picture. There is, for instance, the great invention of sex, with its recurrent mixture of two strains in each generation, its unparalleled possibilities of bodily variation, of being able to invent and try out each tiniest modification that might prove to be of value to the race.

We have left out, also, the story of how life spread upward from the land surface into the air; of the successive invention of flight by five different creatures in five different ways; first the insects, which took wing more than three hundred million years ago; next the great flying reptiles or pterodactyls; then, in turn, the birds and the mouselike bats; and, finally, man himself, who flies because his free hand and his massive brain have permitted him to bend lifeless tools to his uses, to invent machines that do for him what he does not choose to do for himself.

Where Man Has Surpassed Nature

And, finally, a word about one invention in which man has surpassed Nature. This is the wheel. Our two legs may be considered as two spokes of a rimless wheel. They move backward and forward instead of around. Wouldn't a wheel have been better? Could we not move faster and more freely if we rolled along instead of walking?

Mechanically, the answer is yes. Nature has not been able to arrange it because our legs have to be fed. Blood vessels and nerves must run to them from the life centers of the body. Hence there must be a fixed attachment at joint of the hip and rotation through a complete circle is impossible. Our back and forth gait in walking is a price we pay for the advantage that our legs renew themselves and their own energy.

And now may we expect further inventions from Nature? Will she give us bodily wings like the birds, or a few more eyes, or improved gills so that we can live under water if we want to?

Almost certainly not. The path of further evolution seems marked out for us in a quite different direction. It is evolution of our intelligence. Nature's inventions from now on will be, probably, our

inventions; the kind that we record in the Patent Office. When we fly, we shall use airplanes. If we wish to live under water, we shall go there in a submarine.

This has already been true, indeed, for many thousands of years. The bodies of modern men do not differ materially from those of prehistoric men 100,000 years ago. Where man does differ is in his brain; in accumulated knowledge, in greater control of tools and of the non-living forces of nature.

What man is today he has won mentally during his long progress upward from savagery.

¶ Next month—one of the most thrilling chapters in this amazing series.

In it—How science traces our monkey ancestry. The wonder story of man's descent from little catlike creatures that skipped about in the treetops many millions of years ago.

If you have wondered how closely related we are to the monkey and the gorilla, you will find the scientific answer in "The Story of Man and His World" in POPULAR SCIENCE MONTHLY for June.

The next installment of this most thrilling of all human dramas will be on sale at your newsdealers May 10.

For Further Reading

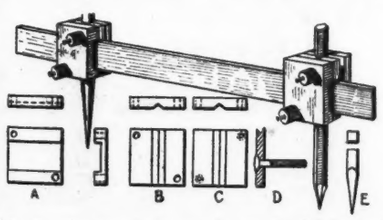
AN EXCELLENT scientific account of the evidence for evolution is "Organic Evolution," by Professor Richard Swann Lull (The Macmillan Company, New York, 1921). "Animals of the Past," by Frederic A. Lucas (American Museum of Natural History, New York, 1922), is an interesting short account, especially well illustrated, of some of the ancient animals and of their contributions to the development of life.

A discussion of the human body as a group is "The Engines of the Human Body," by Sir Arthur Keith (Lippincott and Company, Philadelphia, 1920).

How to Make a Beam Compass for Large Circles

ONLY a hacksaw, a small drill, and a fine file are required in making the neat beam compass illustrated. Such a tool is always valuable in the home workshop when large circles are to be drawn, and this one is particularly useful because it will hold a hexagonal or round pencil, a piece of chalk or crayon, a ruling pen with a handle, or a scriber.

A brass strip ⅛ by ¾ by 5 in. and one length of 1/16 by ⅜ by 18 in. are necessary. Cut out three ¾-in. squares. Then

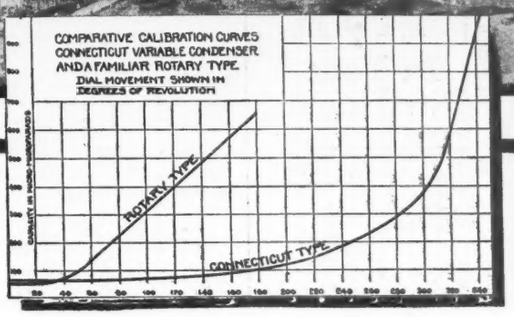


This simple compass can be used with pencil, ruling pen, scriber, or even chalk and crayons

in one of them, *A*, cut a recess ⅜ in. wide and 3/64 in. deep in which a 1/16 by ⅜ in. bar can slide. In a similar piece, *B*, cut a V groove and drill two small clearance holes for the screws that are to be used. In piece *C* cut a V groove and drill and counterbore two small holes so that the screws can be riveted in them. Two sets of these parts are required.

For the screws, *D*, and the knurled nuts it is usually possible to find discarded electrical parts that will serve. The compass points, *E*, can be made of ⅛-in. square brass. The parts are then assembled as shown.—P. A. DASCHKE.

CONNECTICUT RADIO



This Tells the Tale

Which Variable Condenser is Best for Your Set

Up to 400 micro-microfarads—the extreme capacity ordinarily employed in designing circuits for short wave lengths—the CONNECTICUT Variable Condenser has over 300 degrees of dial movement.

This gives a working range two and one-half times greater than that of the plate type instrument. Dial movement makes such slight capacity change that most accurate settings are possible.

These features together with the neatness of its design, the compactness of its construction, the lengths of its scale (350° against 180°), the low waste of signal energy, the impossibility of short circuiting, and the way in which it is shielded from outside fields, all combine to give the CONNECTICUT Variable Condenser an immense advantage over the ordinary plate type of instrument, and make it the most practical improvement you could adopt for your set.

Panel Type, J-108 (Illus.) $5.50

Portable Type, J-107 $6.50

Booklet 100-C describing CONNECTICUT *Variable Condensers in detail will be sent upon request*

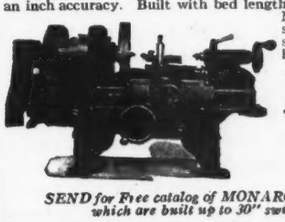
RADIO DIVISION

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
MERIDEN CONNECTICUT

Here's the Lathe for

Inventors—Experimenters Mechanics—Auto Repairmen

Here's the lathe that will exactly answer requirements for a small, compact, accurate, and trouble-proof machine tool for your workshop. The MONARCH Junior 9" Engine Lathe is fully equipped—2½ foot bed—semi-quick change gear—bench legs—automatic safety devices. Will do any small work with 1/1000 of an inch accuracy. Built with bed lengths up to 5 feet. Made in larger size with 11 inch swing at slightly higher price.



MONARCH Junior 9" Lathe

$225

SEND for Free catalog of MONARCH lathes which are built up to 30" swing

THE MONARCH MACHINE TOOL CO.
401 Oak Street SIDNEY, Ohio

PREPARE now for the finest vacation you ever had. Make it possible with the WATERFORD, a complete motor boat that you can pull up on the beach—drive in shallow water—over submerged logs or rocks in absolute safety. A regular family boat—moderately priced—that you will want at your cottage this summer.

Write for illustrated booklet "1500 Miles in Canadian Wilds" and descriptive folder.

DISAPPEARING PROPELLER BOAT CORPORATION
333 Robinson St., North Tonawanda, N. Y.

WATERFORD
The Disappearing Propeller Boat

WURLITZER
500 YEARS OF MUSICAL INSTRUMENT MAKING

Try It In Your Own Home

You may have any instrument for a week's free trial in your own home. No obligation. No expense for trial. Send the coupon.

Easy Payments

A few cents a day will pay. Instruments and complete outfits at factory prices direct to you.

Send for New Catalog Illustrated in Colors

The Rudolph Wurlitzer Co., Dept. 1785
117 E. 4th St., Cincinnati —329 So. Wabash Ave., Chicago
120 W. 42nd St., New York —250 Stockton St., San Francisco

Send me your new catalog, which illustrates and describes every known musical instrument, many of them shown in full colors, all at lowest factory prices. Also tell me how I may have any instrument on a week's trial in my own home at your expense and without obligation, and may pay for it on your special easy payment plan.

Name ----------

Address ----------

(State instrument in which you are especially interested)
Copyright 1922, The Rudolph Wurlitzer Co.

THE HOME WORKSHOP

The Secrets of "Antique" Furniture

(*Continued from page 82*)

worn by long exposure in the sea, have a characteristic embossed appearance that is strikingly decorative.

This can be duplicated simply by burning flat-grained cypress quickly on the surface with a blowtorch. The treated wood is set aside for several days and then scoured both along and across the grain with a steel brush. The color is controlled by the amount of charred surface that is brushed off in this way. Either stain or thin paint can then be applied to color the wood, the paint, if used, being wiped off immediately. It is often, however, finished in the natural color with wax.

To Color Carvings and Moldings

Modern American "antiques" which, according to a saying in the furniture trade, are being made better every day, are often distinguished by the use of polychrome finishes, in the Italian style. The moldings and carvings are touched with colors that blend harmoniously with each other and the general tone of the piece. This is an effect that the amateur can imitate with little difficulty. Get tubes of yellow ochre, Venetian red, and permanent blue in artist's oil colors. Thin the colors a little, if necessary, with oil, and blend them in the moldings, carvings, and other recesses. As they mix on the wood they will form countless color combinations, some bright, some dull. Wipe them off with turpentine in such a way that some of the color will remain in the cuts and recesses. Then burn off the high spots with a little nitric or other acid, and round some of the sharp edges with a scraper. If the work then appears too crude, blend the colors again with diluted acid and neutralize the acid quickly with ammonia. Finally, when the colors have dried, brush thin white lead over them and wipe off in the same way, if it seems necessary.

Remember that the signs of legitimate wear, sometimes even the marks of abuse, give a varied and interesting play of light and shade over the surface of a genuine antique. This quality can easily be imitated by rubbing down the edges of a new piece of furniture with a hard wooden block, so as to leave the edges softened somewhat irregularly, not simply rounded, as would be the case if sandpaper were used.

Imitating Natural Wear and Tear

If you are finishing a table or desk top, be sure to scrape off the finish with a cabinet scraper or broken glass at those places where the forearm would naturally wear the top in the course of years. If it has a foot rail, hollow the upper surface with a spoke shave, to represent the wear of the feet. If you are working on a cabinet, be sure that the drawers bear the sign of wear in those places it would be bound to occur.

If the home worker has access to a source of compressed air supply, such as is in every commercial garage, he can use a sandblast to "antique" the surface of his stock, either before or after it is made up into furniture. For wood that is to have a natural finish, this is about the best method of obtaining an aged appearance because it cuts down the surface in the softer parts of the grain and does not affect the harder fiber, giving much the same effect as long

(*Continued on page 109*)

RADIO

$15 Down $10.22 a Month

An Amazingly Easy Way to Own a Radio Set

Good Radio sets are expensive—but here's the opportunity to buy the VERY BEST on such easy terms that YOU can afford to have the best

The air is full of music—pick out the concert which pleases you—listen to a dozen concerts in one evening. Lectures by the most famous speakers—sermons by world renowned preachers. Baseball scores, returns from the prize fights, news reports of the day sent out hourly by leading newspapers, bed time stories for the little tots. A blessing to the sick, invalids or shut-ins. Brings the world to your door. Far more entertaining than anything else you could buy.

So simple a child can operate—nothing to learn—turn a couple of dials and you have a concert—turn again and you have another. Nothing to buy—the "SENSITONE" comes complete including A and B batteries, head phones, vacuum tube and complete aerial equipment.

SENSITONE
Regenerative Radio Receiving Set
Only $15 Down $10 Month

A Thoroughly Reliable Set, manufactured by the Klitzen Radio Mfg. Co., under the Armstrong License (U. S. Patent No. 1,113,149)

Shelbyville, Mo., hears concerts in Havana, Cuba. A user in Winnipeg, Can., listens to Los Angeles, Calif., while Stanton, N. D., hears Fort Worth, Texas, and Schenectady, N. Y. A party in Denver, Colo., hears concerts from Havana, Cuba. Let us send you copies of hundreds of such letters. A payment of only $15.00 cash and $10.00 monthly brings the "SENSITONE" to you.

Sign the coupon today and your receiver will go forward at once.

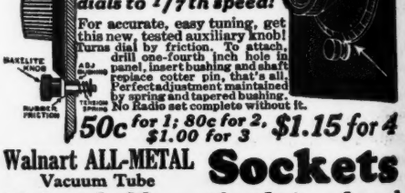
HAROLD R. WAKEM & CO.
836 W. Washington Blvd. Chicago, Ill.

Please ship me one complete "Sensitone" Radio Receiving Set as described above, for which I agree to pay $15.00 herewith and $10.00 per month until the full purchase price of $95.00 is paid. Set to remain the property of Harold R. Wakem & Company until fully paid for.

Name .....

Address .....

Walnart Friction Vernier Knobs



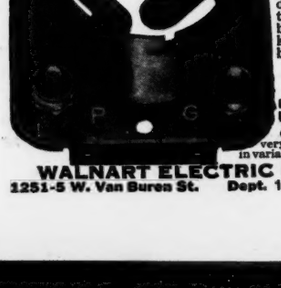
Slow — motion your dials to 1/7th speed!

For accurate, easy tuning, get this new, tested auxiliary knob! Turns dial by friction. To attach, drill one-fourth inch hole in panel, insert bushing and shaft replace cotter pin, that's all. Perfect adjustment maintained by spring and tapered bushing. No Radio set complete without it.

50c for 1; 80c for 2. $1.15 for 4 $1.00 for 3

Walnart ALL-METAL Vacuum Tube Sockets

Unbreakable, perfectly insulated



Do your composition sockets chip, wrap and crack? Install these Walnart ALL-METAL Sockets and you "buy once for a lifetime." Electrically tested. Connections all marked. Standard 4-prong contacts of phosphor bronze. Heavily nickle-plated brass base and shell.

now only 50c

Next month we shall present the Walnart TROUBLE-PROOF CONDENSER. The very newest development in variable Radio Condensers.

WALNART ELECTRIC MFG. CO.
1251-5 W. Van Buren St. Dept. 102 CHICAGO

THE HOME WORKSHOP

Secrets of "Antique" Furniture

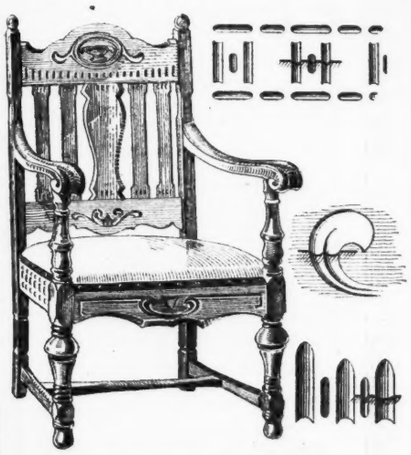
(*Continued from page 108*)

wear. The process should not be used for surfaces that are to be highly polished.

In Elizabethan and other heavy pieces it adds realism to bore holes through mortise and tenon joints or where mortise and tenon joints would have been used if the piece had been made by an old time cabinetmaker, and plug them with dowels to represent pinned mortise and tenon joints. The pins add points of interest to the surface.

What can be done in the way of giving an antique appearance and a greatly increased value to a commonplace piece of furniture is shown by the accompanying illustration of a so-called William and Mary chair before and after the "antiquing" process. The chair was a cheap example of factory furniture of oak, finished a nut brown, with an imitation Spanish leather upholstered seat. It was bought several years ago for about eight dollars.

The first step in remodeling it was to remove the cheap varnish finish with a commercial varnish remover and by scraping. Since the edges were to be rounded more or less, as if by wear, it was unnecessary to take any particular pains with the scraping. In fact, some parts, particularly the lower rails and stretcher, were shaved off with a spoke shave until they were considerably rounded.



A cheap "factory" chair before (above) and after (below) "antiquing"

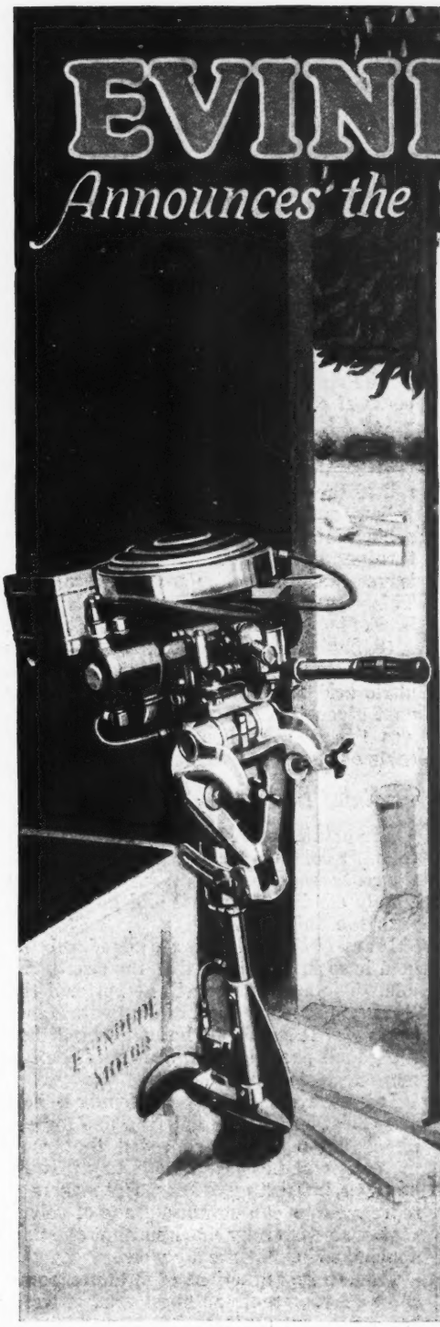
The next step was to improve the appearance of the chair with some very simple carving done with ordinary woodworker's gouges, chisels and penknife. The upper edge of the back was chamfered a trifle at each side. Shallow imitation carving on the back was deepened and extended a little. The work was done in such a way that the marks of the tools remained visible.

A row of gouge marks were then cut across the upper back piece, as shown. The edges of the center slat were beveled and a line of ribbon carving added. The other slats were cut at the edges and relieved with a few straight gouge marks. Other simple carving was used to ornament the lower rail and the back and the front and side rails of the seat.

The arms were hollowed as shown, and

(*Continued on page 110*)

EVINRUDE
Announces the SPORT TWIN



LIGHT, compact, quiet-running, easy-starting—a "twin"—and an Evinrude!

What more could one ask for in a detachable motor?

Climaxing years of experiment and development, the Sport Twin answers Outdoor America's call for a lightweight, two cylinder motor of genuine Evinrude make

—a motor with all the ruggedness, power and speed that the name Evinrude guarantees.

SPORT TWIN FEATURES

Weight 40 pounds complete—no batteries or "extras." Two-cylinder—two-cycle—vibrationless—two H. P. Genuine Evinrude magneto, built-in-flywheel—instant starting.

Automatic Reverse and Tilt-Up—perfect control of boat—absolutely safe.

Genuine float-feed carburetor—wonderful flexibility of power. Glistening in aluminum and nickel—a beauty, and as good as it looks.

See your sporting goods or hardware dealer—now. Write us for free illustrated catalog. (There is now a genuine Evinrude Motor for every small boat use.)

EVINRUDE MOTOR COMPANY
168 Evinrude Block Milwaukee, Wis.

DISTRIBUTORS:
69 Cortlandt Street, New York, N. Y.
780 Commonwealth Ave., Boston, Mass.
211 Morrison Street, Portland, Oregon
119 Broadway, Oakland, California

Complete line of detachable and built-in motors—1 and 2 cylinder models.

BIG MONEY MAKING DOUGHNUTS

AUTOMATIC DOUGHNUT-MAKER makes 800 dozen doughnuts per day. Cost 8c, sell fast for 30c. Profit 22c per dozen. 250% profit. $176.00 daily possible. No experience needed. Flour ready prepared—add water—put dough in hopper—turn crank—out drop sweet, savory, golden doughnuts. Put machine in display window. Attract crowds. Enticing odor whets appetite. You take in money fast. Pay for machine first week. Big Money wholesaling to grocers, restaurants, etc. Get full details FREE. Write today.
Butler & Butler, 5650 W. Lake St., Dept. 21, Chicago, Ill.

Airplane Free
With our course in Building, Flying, Repairing of Airplanes and Motors.
Write for Catalogue No. 1
Lincoln Standard Aircraft Corp.
LINCOLN, NEBR.

7 Diamond Solitaire Cluster $2.00 DOWN

Buy Today 10 Months to Pay

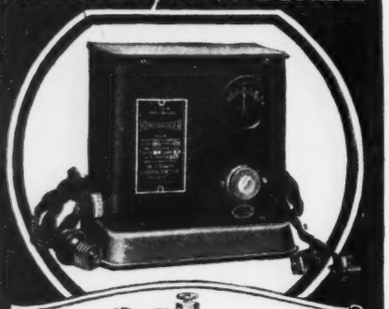
SPECIAL PRICE $55.00

Seven perfectly cut, blue white Diamonds are so closely set in Platinum, and so exquisite is the workmanship that the solitaire resemblance is actually startling. Looks like a 2ct single Diamond. Don't send us a penny—we'll send the Ring without one penny in advance. If satisfied, pay $2.00, then send the balance in ten months, $5.30 a month. If not satisfied return. (Can be furnished in men's setting without extra charge.)

FREE
DeLuxe Diamond Book showing over 2,000 Bargains in Diamonds, Watches and Jewelry—ten months to pay on everything. Write to Dept. 472-K.

THE HOUSE OF QUALITY
CAPITAL $1,000,000
L·W·SWEET INC.
1650-1660 BROADWAY, NEW YORK

CHARGE YOUR RADIO BATTERY at HOME for a NICKEL



PATENTED ARMATURE
Tungsten contacts used exclusively—no silver or carbon points to wear out quickly.

Enjoyable concerts and maximum receiving range are obtained only when your battery is fully charged.

THE HOMCHARGER

charges your "A" or "B" battery OVER NIGHT for a nickel without removing it from your living room. Operates silently — charging rate governed automatically. No muss—no trouble—no dirt—requires no watching.

The HOMCHARGER is the ONLY battery charger combining all of these necessary features. SELF-POLARIZING —FIVE to EIGHT-AMPERE charging rate—UNDERWRITERS' APPROVAL—beautifully finished in mahogany and old gold—UNQUALIFIEDLY GUARANTEED. Over 100,000 now in use.

The minute you buy a radio set you need a Homcharger—get it then. All good radio and electrical dealers sell it complete with ammeter, etc., for $18.50. $25.00 in Canada.

Write for FREE circular showing why the HOMCHARGER is the BEST battery charger at any price.

MOTORISTS — THE HOMCHARGER will also charge your AUTO Battery.

THE AUTOMATIC ELECTRICAL DEVICES CO.
131 WEST THIRD ST.
CINCINNATI, OHIO

Largest Manufacturers of Vibrating Rectifiers in the World

FREE VACUUM TUBE RADIO SET

The set you always wanted—FREE. Real RADIO SET—listen in on Concerts, Lectures, Singing, etc. Can receive 75 to 100 miles and more. RUSH your name and address and we will teach you HOW you can get our VACUUM TUBE RADIO SET.

ABSOLUTELY FREE
Don't delay. Write today for FREE Radio Plan.

HOME SUPPLY CO.
131 Duane St.
Dept. 182, N. Y. City

GREEN AUTOMATIC MACHINE

Add To Your Income

With little effort $5 to $10 a day made easy. New Improved Green Automatic. The only machine on the market that sharpens, hones, and strops all the different blades in one operation.

Write for descriptive literature.

AM. SHARPENING MACHINE CO.
Dept. P. 184 W. Washington St., Chicago

THE HOME WORKSHOP

Secrets of "Antique" Furniture

(*Continued from page 109*)

the corners were cut off the square blocks of the leg turnings. The hard lines of the back legs were varied by a few grooves and chamferings and the corners were rounded a trifle. Turned oak balls were doweled to the top of the back legs. The cheap leather seat was removed and, after finishing, replaced with genuine Spanish leather, and the upholstery nails were set much closer together than before.

The chair was finished by giving it two coats of commercial dark oak stain. Oak paste filler was applied to the parts supposed to appear as if polished by long wear, that is the arms, under rails and the front rail of the seat. When this was dry, red, yellow and blue artist's oil colors were rubbed into the molding and recesses of the turnings and wiped off in such a way as to leave some of the color in the deeper parts. This was followed by a thin white lead brushed over the same parts and wiped off.

On flat surfaces the color was pretty dark and it was lightened in places with diluted nitric acid and a scraper. The chair was next given two thin coats of shellac, each was lightly sandpapered, and then four coats of furniture wax were applied.

Painted Pieces Require Many Coats

For painted work it is merely necessary to apply coat after coat. If one or more of the coats cracks or peels, it will do no harm; simply sandpaper it well and go right on with the finish.

If any of the moldings are gilded, rub the gold hard in places, so that the size is visible. The appearance will be better if the size has previously been colored with Venetian red. It should be borne in mind that the gilded parts of old furniture are often more neglected than the rest.

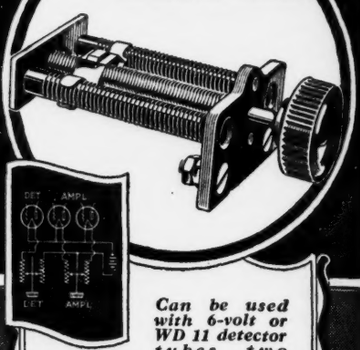
It is always legitimate to use new upholstery, leather, caning and the like for old pieces, because it is conceded that such material will not last indefinitely. It is, however, interesting to know that makers of reproductions can obtain a grade of velvet that is so woven by machine that the nap appears to be realistically worn.

Modern reproductions of antiques, some of which represent the finest cabinet work being done in furniture factories today, at times follow the old-fashioned mortise and tenon construction and parallel very closely the methods used in the piece that is being copied, but often the copy is modern in construction. There is a vital reason for this because modern veneered furniture over laminated cores is built in such a way that it will stand the dry, hot air of the American home in winter, and not check and crack under our great changes in temperature, as do practically all genuine antiques.

Well Seasoned Wood Necessary

In setting out to build "antiques" it is important to obtain well seasoned wood. Many English reproductions are made from wood sawed from the oak timbers of old sailing ships. It is a common practice to pickle ordinary stock in a strong brine solution and then dry it in the sun. A coating of quicklime is sometimes used for bleaching the boards. This is allowed to remain on the wood for several months and then is removed with alcohol applied with a stiff brush.

The Autostat A Super Radio Rheostat



Can be used with 6-volt or WD 11 detector tubes, two amplifying bulbs or one 5-Watt power tube.

The difference between a jumbled mass of signals coming from everywhere and the "sharply-tuned" concerts received clearly and distinctly from far-away stations depends largely upon the careful adjustment of your detector filament current.

Heretofore, sharp tuning has only been partially obtained thru skillful "hair-breadth" manipulations of the filament rheostat. But with

The Autostat A Super Radio Rheostat

these much-sought-for results can be secured by anyone. Just "twirl the knob"—a full turn produces a finer adjustment than a "hair's-breadth" turn on any other.

Economical — neat — small — compact. No carbon to break or change resistance. Unqualifiedly guaranteed. Popularly priced—$1.35.

If the Best is none too good for the set you are building or have bought, see the Autostat at any good radio or electrical dealer Today. Or write direct for Free Bulletin which shows why the Autostat is radio's Best rheostat.

DEALERS — JOBBERS
Write or wire for Radio's most attractive merchandising proposition.

THE AUTOMATIC ELECTRICAL DEVICES CO.
131 WEST THIRD ST.
CINCINNATI, OHIO

Builders of Precision Rheostats since 1914

SPEEDWAY BODIES
New 1923 Models Write for Catalog!

Underslung Parts
MORTON & BRETT, Indianapolis, Ind.

Save Your Tools and Save Money!

A place for every Tool and every Tool in a GERSTNER Case will save both money and Tools. A style, size and price to suit all trades. Catalog free.

H. Gerstner & Sons
345 Columbia St., Dayton, Ohio

CLARENCE A. O'BRIEN

PATENT ATTORNEY

REGISTERED IN UNITED STATES PATENT OFFICE

MEMBER OF THE BAR OF

SUPREME COURT OF UNITED STATES — COURT OF APPEALS DISTRICT OF COLUMBIA

SUPREME COURT DISTRICT OF COLUMBIA — UNITED STATES COURT OF CLAIMS

PRACTICE CONFINED TO PATENTS AND TRADE MARKS

EXPERIENCE SERVICE

Protect Your Ideas

Any new article, machine, design or improvement thereof, or any new combination of parts or improvements in any known article which increases its efficiency or usefulness, may be patented, if it involves invention.

IF YOU HAVE ANY NEW IDEAS

which you feel are useful, practical and novel, *take prompt action toward protecting your rights.* If you have invented any new machine, or new combination of parts or improvement, or new process or design,

Send Drawing, Model or Description

of it for information as to procedure to secure protection.

WRITE TODAY FOR BLANK FORM

"Evidence of Conception"

to be returned to me with drawing, description or model of your idea. Promptly upon receipt by me of your idea I will write you fully as to procedure and costs.

NO CHARGE FOR THE ABOVE INFORMATION

All communications are held in strict confidence. My personal, careful and thorough attention is given to each case. I offer you efficient, reliable and prompt service—based upon practical experience. *Highest references.*

Write to-day for free book *"How to Obtain a Patent."* This book will give you valuable information, and it may save you much time and effort. *Send for it NOW.*

My practice is devoted exclusively to United States and foreign patents and trade marks. Very probably I can help you. Write today.

CLARENCE A. O'BRIEN, Registered Patent Attorney

117 Southern Building - - Washington, D. C.

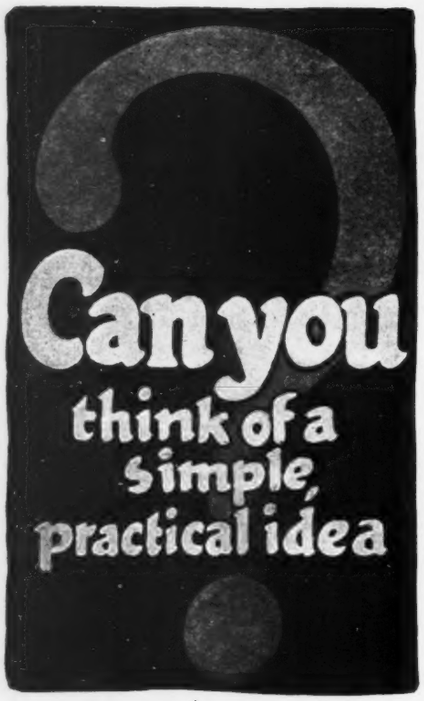
CLARENCE A. O'BRIEN, 117 Southern Bldg.,
Patent Attorney, Washington, D. C.

Please send me your free booklet, *"How to Obtain a Patent"* and blank form *"Evidence of Conception"* without any obligation on my part.

Name .....

Address .....

(WRITE PLAINLY)



A Fortune May be Yours

if you can invent some new, practical thing; or some new and improved method of doing an old thing.

Opportunity Begs You to Reap the Rewards of Original Effort

Protect your ideas; reap the profits from your own genius. Have you a new idea? Can you think of a new and useful invention? We can help you. Write quick for our new free book

"Inventions and Trade Marks, their Protection and Exploitation"

You'll be surprised. This great book tells you many very important and valuable facts on securing Patents and Trade Marks.

It Is Free If You Write Quick

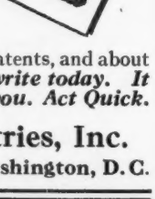
If you have an idea which you think is good, write us for *FREE OPINION.* This may save you considerable money. We help our clients to get the most profits from their ideas; we have facilities not controlled by others, and which are a distinct advantage to YOU.

Patents Advertised Free

In the magazine "Invention and Manufacturing Supplement" published for Inventors. Sample copy free; subscription 50 cents a year.

FREE

SEND FOR THIS FREE BOOK



This book will show you how to proceed; what you should do—and why; it tells you many valuable facts about inventions and patents, and about our service. ***Don't delay; write today. It may mean a fortune for you. Act Quick.***

American Industries, Inc.

515 Kresge Bldg., Washington, D. C.

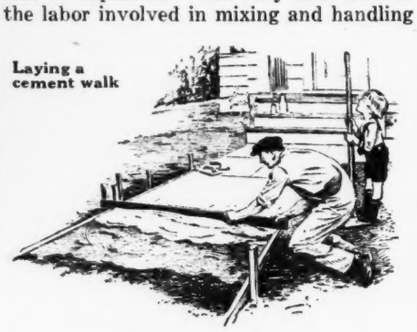
THE HOME WORKSHOP

Simple Methods for Doing Your Own Cement Work

By Franklin S. Keating

HAVE you a garage drive to build, or a garden walk to lay, or concrete steps to patch up, or any cement work to do around your house, garden, and garage? If so, you can save money by doing the work yourself, or, at least, by supervising it intelligently.

No material can be handled more easily by the home worker and with less equipment than concrete. From patching a curb to casting ornamental garden furniture, there is little limit to the possible uses of cement. And the work is not difficult or expensive. The only drawback is the labor involved in mixing and handling



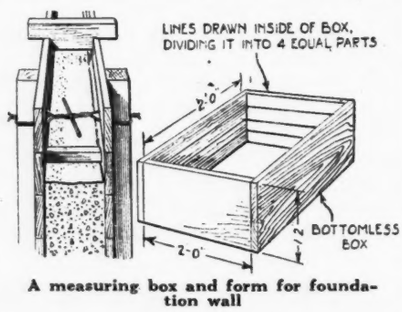
Laying a cement walk

concrete, and that often can be done under your direction by a laborer hired by the day or hour.

The mixing platform should be built of rough green stock. A convenient size is 8 by 14 ft., but a smaller board will serve for most work around the house. A strip nailed to the outer edges on three sides will make it easier to prevent cement being washed over the edges.

A square pointed shovel is best for the mixing. A hose or water apparatus, a sprinkling can, a wheelbarrow, a screen for sifting sand, buckets, a steel trowel and a wooden float are also required. If much sidewalk is to be laid, a groover and edger should be obtained. A tamper can be made if a commercial one is not obtainable.

The best way to measure the correct proportions of sand and aggregate is to make a bottomless box 1 by 2 by 2 ft. inside and mark it on the inside with lines 3, 6, and 9 inches from the bottom. The frame is placed on the mixing board and filled up



A measuring box and form for foundation wall

to the first level if 1 cu. ft. is desired, to the second level for 2 cu. ft., to the third for 3, and to the top for 4. For small work a mixing frame 6 in. by 1 ft. by 2 ft., containing 1 cu. ft., will be large enough. One bag of cement is considered to be 1 cu. ft., so that the cement does not need to be measured if used in quantities of one bag or more.

(*Continued on page 113*)

DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE

274 Ouray Bldg.
WASHINGTON, D. C.
Originators of forms "Evidence of Conception."

PATENTS

Booklet Free **Highest References**
Promptness Assured **Best Results**

Send drawing or model for preliminary examination of Patent Office records and report as to patentability.

All Business Given Prompt and Proper Attention

WATSON E. COLEMAN, Patent Lawyer,
624 F St., Washington, D. C.

PATENTS

PROTECT YOUR INVENTION TODAY
Write for FREE Illustrated Patent Book
Radio-Electrical. Chemical and Mechanical Experts; Over 25 years' experience. Prompt Efficient Service. Write today

A. M. WILSON, Inc.
308-20 VICTOR BLDG. WASHINGTON, D. C.

PATENTS

As one of the oldest patent firms in America we give inventors at lowest consistent charge, a service noted for *results*, evidenced by many well known Patents of extraordinary value. *Book, Patent-Sense, free.*
Lacey & Lacey, 648 F St., Wash., D. C. Estab. 1869.

PATENTS and TRADEMARKS

We offer a strictly professional service to inventors and manufacturers in the protection of their patents and trademark rights. Validity and infringement investigations conducted. Correspondence solicited. Moderate fees. Preliminary advice without charge. No literature.

MILO B. STEVENS & COMPANY
Suite 400 Barrister Bldg., - WASHINGTON, D. C.
Suite 337 B Monadnock Block, - CHICAGO
ESTABLISHED 1864

PATENTS

TRADE-MARKS, COPYRIGHTS AND PATENT LITIGATION
Write for advice and instructions how to proceed, costs, etc.
Hand Book with illustrations of 100 Mechanical Movements sent free on request.

ALBERT E. DIETERICH
Patent Lawyer and Solicitor
Successor to Fred G. Dieterich & Co.
60 Ouray Bldg. WASHINGTON, D. C.

THE HOME WORKSHOP

Simple Methods for Cement Work

(*Continued from page 112*)

The recommended mixtures for various classes of work are as follows:

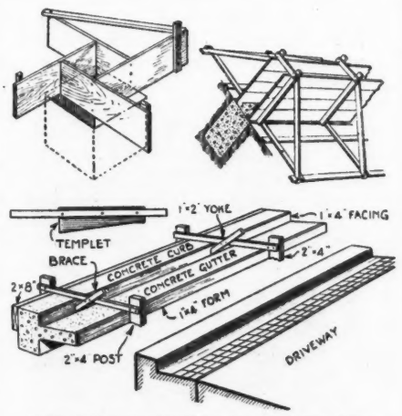
	Cement	Sand	Aggregate
Barnyard stable floor	1	2	3
Drives for trucking	1	2	3
Fence posts	1	2	3
Foundation walls and piers	1	2½	5
Garage drives	1	2	4
Garage floors, one course	1	2	3
Garage floors, base course	1	2½	5
Garage floors, surfacing coat	1	2	
Garage foundations	1	3	5
Garden seats, flower boxes, pedestals, etc.	1	2	
Garage walls (6 in. thick)	1	2	4
General reinforced concrete	1	2	4
Large footings	1	3	6
Machinery bases	1	2½	5
Roads	1	1½	3
Septic tanks	1	2	3
Steps	1	2	4
Tanks and cisterns	1	1½	3
Walks, base course	1	2½	5
Walks and floors—surfacing coat	1	2	
Walks and floors laid in one course	1	2	3

Suppose a 1:2:4 batch is needed. First measure 2 cu. ft. of sand and spread 1 bag of cement over it, mixing thoroughly, first dry and then wet; next spread out the mortar and place 4 parts of stone on top and mix thoroughly, adding water as required.

If a lighter aggregate is used, such as fine gravel or ashes, it can be mixed dry with the cement and sand before adding water. The object is to have each grain of sand coated with neat cement, and each particle of aggregate coated with the sand and cement mortar.

For forms, green timber or lumber that is only partly air-dried is actually better than more expensive kiln-dried lumber. The lumber should, however, be of even thickness and preferably planed on one side. The boards should not be wider than 4, 6 or at most 8 in.

Typical methods of constructing forms are illustrated. Care should be taken to



Standard construction for various types of forms

make the forms strong enough, since concrete weighs from 130 to 150 lbs. a cu. ft. When forms are to be used repeatedly, they should be oiled or greased beforehand or brushed with oil and graphite. A good oiling mixture is equal parts of boiled linseed oil and kerosene. Even if not oiled, the forms should be thoroughly wetted before use and cleaned afterward.

For foundation walls and similar work the earth usually will serve as one side of the form up to the ground level. Forms should be left in place until the concrete is thoroughly set. Any heavy work is left from ten days to a month. Rods and bars

(*Continued on page 114*)

PATENTS TRADE-MARKS AND COPYRIGHTS

SPECIAL OFFER FREE OPINION AS TO PATENTABLE NATURE

Before disclosing an invention, the inventor should write for our blank form **"Record of Invention."** This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Assignment or SALE OF PATENTS, Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding *Trade-Marks and unfair competition in trade.*

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. We secure Foreign Patents in shortest-time and lowest cost.

LIST OF PATENT BUYERS SENT FREE

IDEAS WANTED: Send for LIST OF PATENT BUYERS, containing unsolicited Letters from Manufacturers and others WISHING TO BUY meritorious patents. There is a great demand for NEEDED INVENTIONS. We endeavor to assist OUR clients in the commercial development of their inventions.

SPECIALIZATION Our Staff

The field of invention is so vast that it is impossible for any one to become an expert in all the different classes of invention. For this reason Victor J. Evans & Co. employ a number of patent lawyers and mechanical experts who have been selected for their special knowledge and ability in certain lines of invention.

THE VALUE OF YOUR PATENT

Will depend much upon the skill and care with which your case is prepared and prosecuted in the United States Patent Office. Every case receives our best efforts, and our work is done consistently, skillfully and thoroughly, as is evidenced by the many unsolicited letters of commendation received from our clients. We will furnish lists of clients from any State in the Union for whom we have secured patents.

Our New York, Philadelphia, Pittsburgh, Chicago, and San Francisco Offices

We have established for the benefit of our clients Branch Offices in New York City, Philadelphia, Pa., Pittsburgh, Pa., Chicago, Ill., and San Francisco, Cal. These branch offices located in these large commercial cities, together with our Main Office located near the U. S. Patent Office, in Washington, enable us to more promptly handle the business of our clients, particularly as the branch offices are in constant touch with the Main Office.

Highest References—Prompt Attention—Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO.
Patent Attorneys

New York Offices 1007 Woolworth Bldg. | Philadelphia Offices 714-715 Liberty Bldg. | Pittsburgh Offices 514 Empire Bldg.
Chicago Offices, 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg.
Main Offices, 760 9th Street, Washington, D. C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....Address.....

WANTED IDEAS

Inquiries from Manufacturers and Others Who Are Looking for Good Ideas

PROTECTED BY PATENTS

are constantly being received. Manufacturers are always interested in any new device for which there is a market, which fills a long felt need, makes production possible at a lower cost, or which will do the work BETTER. There is undoubtedly a great demand to-day for really worth while inventions.

Your First Step

If you have an idea, send immediately for my blank form "TO RECORD YOUR INVENTION." You should serve your own best interests by filling out and signing this form before you disclose your invention TO ANY ONE. This document will help you determine and establish evidence of invention before filing an application in the U. S. Patent office. A copy, with full instructions, will be gladly sent free on request.

New Book* "Successful Patents" *Sent FREE

Every man who has an invention or ever hopes to have one, should send for a copy of my book, "SUCCESSFUL PATENTS." It tells what everyone should know about patents, trade-marks, copyrights, etc. It describes my methods, fees and terms, gives information relative to assignment or sale of rights and instructions in detail. Mail coupon to-day for a free copy of this book—or a postcard request will do.

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection, and will endeavor to aid him in the commercial development of his proposition—my service is distinguished by over 12 years' successful practice, and by thousands of satisfied clients and by reasonable fees.

Send sketch, or model, and description, for advice as to cost, opinion as to its patentable nature, etc. Preliminary advice gladly furnished without charge.

COUPON

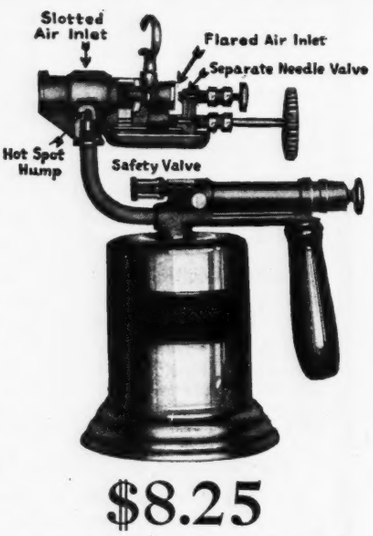
RICHARD B. OWEN, Patent Lawyer

Main Office, 6 Owen Bldg., Washington, D. C. — *Branch Office,* 2276-D, Woolworth Bldg., New York City

Please send me, without charge, or other obligation, a copy of your book, "SUCCESSFUL PATENTS," your form "TO RECORD YOUR INVENTION," and information concerning patents, etc.

Name..... Address .....

Only Safe Blow Torch



The Turner "Master" Burns Kerosene or Gasoline—

Only torch with Safety Valve and Air Release, thus preventing excess or bursting pressure.

Only torch with but one opening in tank—and that far above the fuel.

Only torch with vaporizing baffle—our patented "Hot Spot Hump" that becomes white hot and instantly converts gasoline or kerosene (use either fuel) into a hot dry gas.

$8.25

400° MORE HEAT

Only torch with adjusting valve fuel control wholly separate from shut off valve. This not only prevents enlarging the orifice but it gives a finer control of the size and intensity of flame.

Only torch with automatically-lubricating pump-leather. This means easy pumping and no leakage of air around the valve.

Only torch with pistol grip handle—always comfortable.

All these features are *patented*. You won't find them in any other torch.

If your dealer has not yet stocked this line of torches, send money order for $8.25 and *his name and address*, and No. 45 torch illustrated, capacity 1 qt., weight 4½ lbs., will be sent you prepaid. Ask for our catalog, showing many other sizes and types.

THE TURNER BRASS WORKS
Sycamore, Ill. U.S.A.
Ashland Avenue

THE HOME WORKSHOP

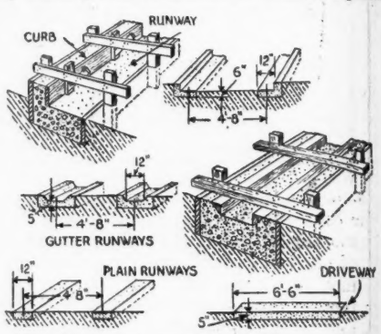
Simple Methods for Cement Work

(*Continued from page 113*)

usually are used for reinforcing concrete, but for light work poultry netting or wire serves very well and is cheap and easy to handle.

It is usually better to spade the concrete into place than to tamp it. An old garden spade or a hoe straightened out are good tools to use.

To join new cement to a section laid the day before, wash the surface well and paint



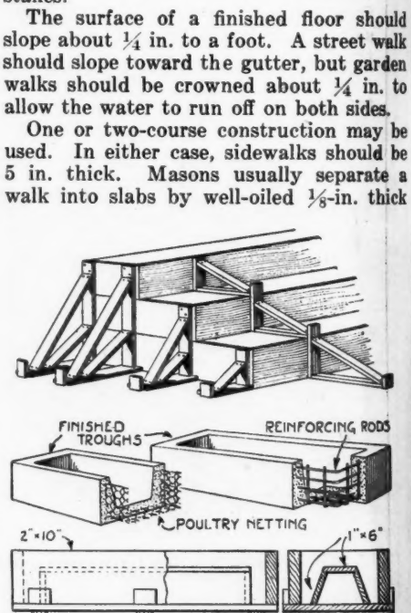
Four different ways for making garage drives or runways

it with cement and water mixed to a creamy consistency.

Concrete for a walk should be laid only on firm, well tamped or trodden ground. Soft places should be dug up and filled with clean gravel or hard cinders. The form should be built of 2-in. timber as wide as the floor or walk is to be thick, and it usually can be held in position with stakes.

The surface of a finished floor should slope about ¼ in. to a foot. A street walk should slope toward the gutter, but garden walks should be crowned about ¼ in. to allow the water to run off on both sides.

One or two-course construction may be used. In either case, sidewalks should be 5 in. thick. Masons usually separate a walk into slabs by well-oiled ⅛-in. thick



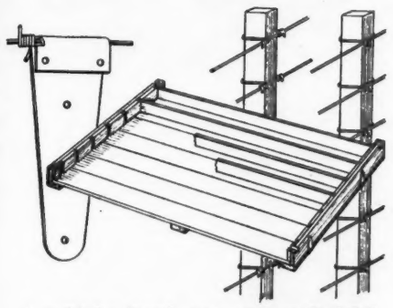
Trough construction and form for steps

steel plates, which are removed as soon as the concrete is hardened sufficiently. Otherwise care must be taken to cut completely through the concrete when the slab joints are marked out.

A good way for the home worker to lay a walk is first to fill in every other slab and later fill in the intervening places. Care in this detail will prevent the walk's cracking. The edge of each slab should be rounded.

In two-course work the base used may be

4½ in. of 1:3:5 mixture and a ¾-in. finishing coat of 1:2 cement mortar. A light roller can be used on the concrete as soon as it has been leveled and before the final finish is given with a trowel or float. Al-



A mold for bench posts and methods of attaching fence wire to the concrete

though not general practice, walks should be covered and kept moist for several days to prevent too rapid drying.

Concrete drives to the garage should be about 5 in. thick at the side and 6 in. at the center. As in the case of sidewalks, they should be covered with 2 in. of sand or earth or other moisture retaining material for at least ten days, and no traffic should be allowed for at least two weeks. If the road is more than 25 or 30 ft. long, provide at least one expansion joint filled with tar paper or asphaltic felt. Concrete strips or runways will often serve instead of solid road to the private garage. The various types of garage drives are shown in the upper illustration on page 114.

Gang molds for posts may be made as shown above. Four or more reinforcing rods should be placed in each post so as to come about 1 in. inside the corners.

Concrete surfaces may be patched up where necessary and left as they appear when the mold is removed, or they may be painted with one part cement and one part fine sand. They may also be washed so as to remove the surface film of cement; this reveals the natural color of the aggregate, which is particularly desirable when selected aggregate, such as granite screenings, feldspar or hard black slag, are used. If the forms cannot be removed soon enough for the washing process, the surface may be scrubbed, even if it is quite hard, with 1 part common muriatic acid to 3 or 4 parts of water. Other finishes may be obtained by tooling or bush hammering the surface.

Many interesting co'or effects can be obtained with colors such as red oxid of iron, mineral Turkey red, metallic brown oxid, yellow ocher, ultramarine blue, chromium oxid, and lamp or carbon black.

Other Uses for Concrete

IF YOUR particular concrete problem is not covered in the accompanying article (pages 112-115), write for further assistance to the Information Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Concrete can be put to such an endless number of useful purposes around the home, farm, and shop, that it is impossible to give more than a general outline of procedure in a magazine article; but detailed information in regard to practically every type of concrete job is on file in the Home Workshop reference library.

PATENTS

Seventy-six Years of Practice

THE firm of Munn & Company filed its first application for a patent in 1846, and for seventy-six years has endeavored to keep pace with the inventive genius of the United States. An experience of many years is at your disposal. If you have an invention which you wish to patent, send your sketches or model together with a description of your device, explaining its operation, and you will receive prompt, courteous attention.

Write for our Handbook on
PATENTS

A full and complete booklet on Patents, Designs, Trade-Marks, Foreign Patents, Copyrights, Labels and Patent Office Practice with an explanation about our methods, terms, etc.

All communications strictly confidential

Keep in touch with the inventions of the world by reading
SCIENTIFIC AMERICAN

The MONTHLY MAGAZINE with a special appeal to every man of inventive genuis. Recent rulings of the Patent Office, descriptions of the latest patented inventions, legislation and court decisions affecting patents, are noted in this authoritative publication.

MUNN & COMPANY
Patent Attorneys
683 Woolworth Building, New York City

Scientific American Bldg., Room 3, 625 F Street, Washington, D.C.
801-D, Tower Building, Chicago, Ill.
602 Hobart Bldg., San Francisco, Cal.

PATENTS
TRADE-MARKS COPYRIGHTS
Send for our free book of patent information
Beale & Park 804 F St., Washington, D. C. 16 S. Broad St., Philadelphia, Pa.

PATENTS
Send us sketch or model for patentability opinion and exact cost of patent. Our book **"How to Obtain a Patent"** Sent Free on request. It tells how to apply for Patents, Trade Marks, Foreign Patents, Copyrights, etc.; gives information on Patent Procedure; tells what every inventor should know. Thousands of inventors, who are our clients, are our references.
CHANDLEE & CHANDLEE, 25 Years' Experience
437 7th St. Washington, D. C.

PATENTS IF YOU HAVE AN INVENTION *and* DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, HOW TO GET A PATENT, sent free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

NAME.....
STREET.....
CITY.....STATE.....

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NEW Butter-Kist Machine Brings BIG Profits from SMALLER Investment!

BUTTER-KIST now offers a new and wonderfully improved line of Popcorn Machines with the *right* model, *exactly suited to the requirements of your own business.*

And best of all—there's a beautiful, brand-new model that sells at *half what former models cost!*

It's the Gold Mine—and it's a beauty. Mahogany-finished cabinet—gleaming glass sides—polished nickel parts. Takes up little room. Works automatically. Produces thirty 10-cent packages an hour. Has special compartment for peanuts—a chance for added profits.

A better machine in every way! Pops *more* corn at same cost. And pops it *under glass.* No springs. Noiseless. Every part interchangeable. New and improved *revolving* electric sign.

Butter-Kist Popcorn *can* make big profits for *you.* H. C. Wallace writes: "In one year we made a gross profit of $3484". Many are making even more. And remember, out of every dollar's worth you sell, you keep 65 cents as *your* profit!

The Gold Mine Model is your opportunity. Write for the Butter-Kist Easy Payment Plan. Mail the coupon.

Butter-Kist Popcorn
"America's Oldest Treat"

HOLCOMB & HOKE MFG. CO.
World's Largest Manufacturers of Popcorn Machines and Peanut Toasters
2180 Van Buren St. Indianapolis

HOLCOMB & HOKE MFG. CO.,
2180 Van Buren St., Indianapolis, Ind.
Please send me, without obligation on my part, your free Butter-Kist book. I also want the Location Chart which I will fill out and return to you.
Name _____
Street _____
City and State _____
Business _____

The coupon, filled-in, offers you an easy road to big profits. Obligates you in no way. Fill it in and mail TODAY.

BUTTER-KIST
Popcorn and Peanut Machines

THE HOME WORKSHOP

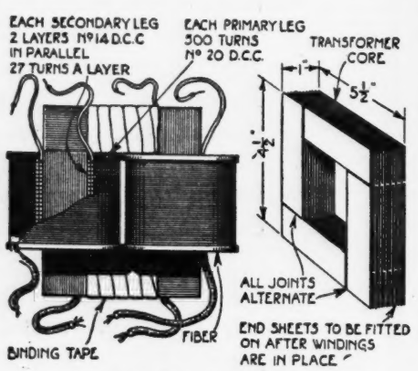
Portable Searchlight for House

(Continued from page 80)

a bolt to hold the bracket to the transformer case.

The case can be made to suit the ideas of the builder and need be just large enough to hold the transformer. If of metal, the case should not be continuous, but split down one side, otherwise it will act as an extra secondary coil and cause an excessive amount of current to be used.

So many articles have been written upon the subject of small transformer construction that but little need be said, as this one is of the conventional type and designed



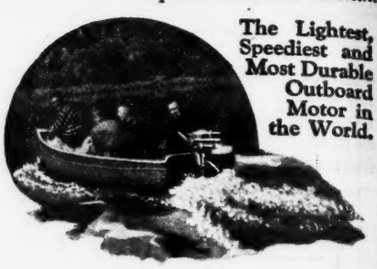
How the transformer core is made and the coils are wound

for a frequency of 60 cycles. Thin sheet iron used for tin cans, with the tin melted off, can be used for the core, or "stove" iron will serve. The core should be 1 in. thick when completed. Strips 1 in. wide and 3½ and 4½ in. in length will be needed. The longer ones are piled up, overlapping alternately at the ends for 1 in., and wrapped with tape and insulation. The fiber or hardwood core ends are driven on, the windings completed, and then the shorter strips are placed at the ends, thus completing the core.

The secondary windings are put on first. They consist of two layers of No. 14 d.c.c. copper wire on each leg. Each layer has 27 turns and the two layers are connected in parallel on each leg, instead of series, giving the effect of 27 turns of much heavier wire, which would be difficult to wind. After the secondary coils are shellacked, dried, and well insulated, the high voltage fine wire primary windings are put on; they consist of 500 turns of No. 20 d.c.c. magnet wire on each leg. The ends are soldered to lengths of flexible lampcord, which are brought out through the coil heads.

If 110 volts is to be used, connect the primary coils in parallel; 220 volts will require them in series. Independent of the primary voltage, connecting the secondary coils in parallel will give about 6 volts at the searchlight terminals; in series, about 12; other voltage can be allowed for by giving the secondary coils the proper number of turns. The snap switch should be connected with the high voltage house circuit rather than with the low voltage transformer terminals.

TO FRESHEN up the appearance of an automobile, the finish of which has begun to look dull, try using linseed oil and a little varnish, stirred well together. This should be prepared in the proportion of about ⅛ pt. varnish to 1 qt. oil. The mixture should not leave a tacky surface.



The Lightest, Speediest and Most Durable Outboard Motor in the World.

Almost as Easy to Carry as a Pair of Oars

Makes a speedy power boat or pleasure launch of any boat or canoe. A boy or girl can handle it. The whole family enjoy it. 2 H.P. Twin Cylinder.

Weighs Only 35 Lbs.

15 to 50 pounds less than usual, yet guaranteed more durable. Has real carburetor, real magneto—no batteries to carry—spark and throttle control like auto, instant reverse, self tilting and ten other valuable features. Write for Free Catalog folder today.

JOHNSON MOTOR CO.
906 Sample St., South Bend, Ind.
Eastern Office
120 Broadway, New York City

Johnson "WATER-BUG"
THE LIGHTEST, LIVELIEST BOAT MOTOR ON THE WATER.

AGENTS Some Seller at **$2.00**

Books Like $5.00 Worth Gives You $1.10 Profit

$12 AN HOUR!

W. H. Marion, a beginner made 36 sales in three hours, first day, $36 profit! How? Our representatives introduce our products with a first sale of beautiful combination sets of Toilet Articles, Soaps, etc. You sell at half store prices—no fancy talk—sell on sight. Make 20 to 30 sales a day with $1.10 profit on each. Easy to average $100 a week. Could you ask more while introducing line, establishing a permanent business for yourself? Another plan calls for no deliveries, no investment, no delays. You bank immediate profits. Also a plan with winning premium to each sale. Write quick for full details.

FORD FREE! No contest. Every producer gets a Ford Car absolutely free. Most amazing offer ever made. Don't waste a minute. Write TODAY for illustrated circulars explaining our **Unique Plans** including 30 other packages. ACT NOW.

E. M. DAVIS CO. Dept. 5705 Chicago

FREE BASEBALL OUTFIT
RUSH your name and address and we will tell you HOW you can get this Baseball Outfit, consisting of Baseball Suit, Cap, Fielder's Glove, Live League Baseball, Catcher's Mitt ABSOLUTELY FREE. Write at once for FREE Baseball Outfit.
GLOVE
BALL
MITT
SUIT
HOME SUPPLY CO.
131 Duane St., Dept. 544 NEW YORK

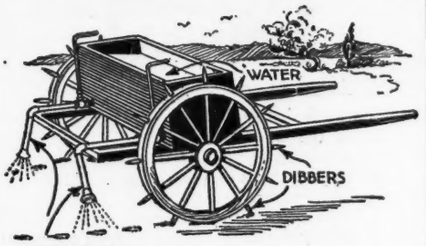
$25.00 in Prizes
See page 6 in front of book for full details

THE HOME WORKSHOP

Automatic Dibble Saves Time in Transplanting Small Plants

HAVING to transplant many thousands of plants of growing celery for the market, I find that much time can be saved by the use of an automatic dibble.

Each wheel is 2 ft. in diameter and 3 in. wide, with two 1-in.-wide iron tires placed so as to leave a 1-in. space in the center of the wheel face. In this space holes are



Spaces holes automatically and sprinkles them with water

bored 6 in. apart and pointed pegs of very hard wood are driven into the holes.

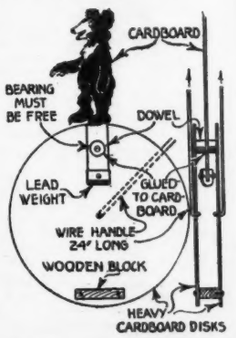
By means of a watertight wooden tank and pipe or hose, a supply of water is carried back of the wheels directly over the dibble holes. The spray of water passes through cups with sieve bottoms so gently that the earth is not disturbed, as it would be by a direct stream. Stopcocks regulate the water discharged through the hose.

The cart itself is drawn by two men. It saves about half the time of my former method.—W. H. J., Sidney Center, N. Y.

"Teddy-Be-Nimble" Toy

THIS unusually funny toy can easily be made by the man who enjoys constructing playthings for his children. The comic looking bear is mounted between two disks in such a way that when the toy is pushed along, the bear comes popping up above the wheel at intervals and then disappears.

The wheel is made of two disks of heavy cardboard held together by a small block of wood on the bottom and two short lengths of dowel at the top into which run the rails that form a support for the bear.



The bear pops up and down

The bear is drawn on paper and pasted on cardboard long enough to extend down to where the weight is attached. The bear can be duplicated on the reverse side, if desired. The bear is then cut out and a weight attached to the lower end of the cardboard, as shown. The disks are fastened to the block and dowels with flat-headed nails, and a suitable handle is made of wire. The end of the handle is bent so as to slip through holes at the center of the disks. A colorful design can be painted on the disks or they can be left plain.

The bearing for the bear must be free so as to turn easily, and the lead weight must be trimmed until it is just sufficiently heavy to overbalance the bear.—D. W. C.

Own This GENUINE DROP FORGED STEEL ASTRA AUTOMATIC

Buy Direct from Sole U.S. Importers and Save 1/2

The ASTRA is the finest European Pistol and the equal of any similar American weapon retailing at $15 and $25 up! It is the standard of the Spanish Army, and after exhaustive tests was adopted by the French Army during the war. The **ASTRA** has heretofore always been sold through retail stores, but the competition of cheap cast iron pistols has forced us to sell **Direct to You,** ELIMINATING THREE PROFITS—**Jobber, Wholesaler and Retailer!**

WARNING! Cast iron guns are very dangerous! We **Guarantee** the **ASTRA** is of **Drop-Forged Steel throughout!** Before buying any weapon, **INSIST** on this guarantee. We also absolutely guarantee the **ASTRA** against inferior workmanship! If you are not entirely satisfied, return within 10 days and we will immediately refund your money.

SEND NO MONEY

—unless you wish. Fill out coupon, write name and address plainly, showing gun you wish. We will ship by return mail.

$8.95 25 Caliber 7 Shot Automatic With Triple Safety $9.95

$10.95 32 CALIBER 10 Shot Automatic Latest Model

BOTH MODELS SHOOT ANY STANDARD AMMUNITION

.25 cal. model, 4 5/8 in. long by 3 1/4 in. high—an ideal gun for a man or woman. Substantial .32 cal. military model 6 1/4 in. long by 4 3/4 in. high. Blue steel, beautifully balanced, swift—accurate! Superb workmanship and materials throughout. A gun you will be proud to own. Write for free catalog.

Protect Your Home and Loved Ones. Mail This Coupon Today!

California Trading Company
Dept. 15. Terminal Bldg. Los Angeles, Cal.
In accordance with the terms of your advertisement, send me.....ASTRA AUTOMATIC. I am enclosing money order for..... Or, I will pay postman on arrival.

Name.....
Address.....
City..... State.....

5 Master Keys

Work like magic in emergencies or prove whether your door or padlocks are burglar-proof. **Open and test thousands of different locks.** Recommended by users in ten different nations. Most wonderful and only keys of their kind. Send $1 today. Novel key chain **FREE** with set.

Master Key Co., 6-S Manhattan Block, Milwaukee, Wis.

DIAMONDS-WATCHES CASH or CREDIT

Send for Free Catalog Over 2000 illustrations. Everything fully explained.

$1.00 a Week for this $50 RING

LIBERTY BONDS ACCEPTED

"Lady Leslie" Diamond Ring. Blue white, perfect cut Diamond, set in 18-k Solid White Gold prongs. Ring is Solid Green Gold. Special at $50. Others at $75, $100, $150 up.

LOFTIS BROS. & CO.
Dept. N-871 108 N. State St., Chicago, Ill.

—that eyes may see better and farther—

Photo by C. H. Thomas, using a Tessar Ic Lens

An interesting booklet, "What Lens Shall I Buy?" describes our complete line of anastigmat lenses. Write for a copy, and see the Tessar at your dealer's.

BAUSCH & LOMB OPTICAL COMPANY
603 St. Paul St., Rochester, N. Y.
New York Washington Chicago
San Francisco London

No Speed Too Fast

A running horse—a rush ng car—a speeding boat—the Bausch & Lomb Tessar gets them clearly and sharply. No lens can surpass it for speed work, yet its remarkable definition at full opening makes possible snapshots indoors or on cloudy days when ordinary lenses require time exposures.

The Bausch & Lomb TESSAR LENS

is *the* anastigmat lens for both amateurs and professional—made by America's leading optical house.

"Another $50 Raise!"

"Why, that's the third increase I've had in a year! It shows what special training will do for a man."

Every mail brings letters from some of the two million students of the International Correspondence Schools, telling of advancements won through spare time study.

How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait for years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in your own home will prepare you for the position you want.

Without cost, without obligation, mark and mail this coupon. *Do it right now!*

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7639-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING DEPARTMENT

☐ Business Management	☐ Salesmanship
☐ Industrial Management	☐ Advertising
☐ Personnel Organization	☐ Better Letters
☐ Traffic Management	☐ Foreign Trade
☐ Business Law	☐ Stenography and Typing
☐ Banking and Banking Law	☐ Business English
☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
☐ Private Secretary	☐ High School Subjects
☐ Business Spanish ☐ French	☐ Illustrating

TECHNICAL AND INDUSTRIAL DEPARTMENT

☐ Electrical Engineering	☐ Architect
☐ Electric Lighting	☐ Blue Print Reading
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name.....
Street 1-10-23
Address.....
City.....State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

COOK WITH AIR!
IN YOUR OWN RANGE!

An amazing new invention, in one minute, makes any range a real gas stove without changing—does away with dirty coal and wood—keeps kitchen cool on the hottest day! Don't clutter up kitchen with a smelly oil stove—this invention sets right in to your present range—just turn a valve and you have much or little heat, when and as you want it—instantly.

Wonderful Baking and Cool Kitchens

Best of all you can bake with your old oven—better than ever before—turn out the prettiest batch of biscuits or bread you ever saw—bake cakes or pies to a golden brown turn. Then turn the valve—fire is off instantly—kitchen cool and sweet.

Ends Summer Drudgery

The **OLIVER Oil-Gas Burner**—burns 95% air, 5% oil, cheapest fuel there is. No more smoke, ashes, dirt, drudgery. No wicks, no soot, no odor. No chopping, carrying dirty coal and wood. **16 models fit every range or cookstove.** Absolutely safe. Lasts a lifetime. 150,000 already in use. Special Low Introductory Price and

30 Day FREE TRIAL OFFER

Write quickly for this offer and wonderful Free Book, showing how women are freed from Summer Drudgery over red hot stoves. Send letter or card to

AGENTS!
OLIVER representatives make big money—$500 and more a month. Exclusive territories. Oliver gives Fords away to producers. Big season just starting. Write at once—Free Sample Case Offer.

OLIVER OIL-GAS BURNER & MACH. CO.
2007-E Oliver Bldg. St. Louis, Mo.

THE HOME WORKSHOP

Radio Trouble Tips to Aid You in Building Your Set

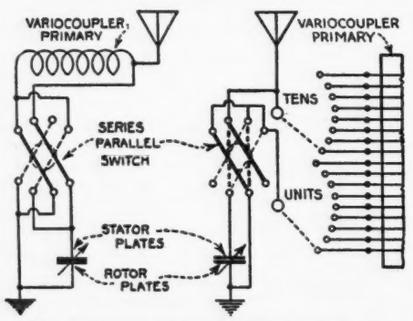
By Jack Binns

Radio Editor of
POPULAR SCIENCE MONTHLY

FOR users of honeycomb coils, one of the most important parts of their set is the series-parallel switch. This will be still more important if broadcasting is put on higher wave lengths. Most of the diagrams I have seen for wiring this switch are incorrect, as they usually short circuit the condenser when the switch is in the parallel position. The correct way as ordinarily wired is as shown in the diagram below at the left.

Generally speaking, the series-parallel switch controls the primary condenser so as either to increase the wave-length range of a set or decrease it with each size coil. When the condenser is in series, the wave-length range of the particular coil is decreased; and when the condenser is in parallel, the range is increased.

One of the most important tips that I can think of is in connection with the use



The ordinary series-parallel hook-up is shown at the left, and, at the right, a variation that allows the condenser to be cut out of the circuit entirely

of bypass condensers, such as the telephone and transformer condensers. These are used for the purpose of allowing a pathway of low impedance for the high frequency currents in the circuit, without interfering with the normal function of the low frequency current. Wherever such condensers are placed across the B battery in addition to the telephones, they should be of the mica dielectric type, as paper may not stand up against the voltage placed across them.

Never forget that in vacuum tube circuits most extraneous noises in the telephones are caused by loose connections. These noises may be of the grinding variety, or, more often, terrific shocks. When you hear them, always go over your connections carefully, especially the battery connections. This applies equally well to those fans who are using standard receivers, because the operator is the one who connects the batteries with the set.

Another frequent cause of trouble lies in the place where the majority of fans never think of looking for it—the vacuum tube socket. The prongs of the tube make contact with flat springs at the bottom of the socket. Sometimes a tube prong is a little short, or the contact spring in the socket may have lost some of its tension. If this condition exists at the filament springs and prongs, the tube will not light, and it will be readily apparent. If, however, it is at the grid or plate contacts, it will not be so easily detected.

(*Continued on page 119*)

This Is It

The torch that enables you to fix the wiring on your car, repair electric fixtures, mend kitchen utensils, solder connections on Radio sets, in a quick, workmanlike manner. **Lenk Super, 75c**

Produces a 1400° needle-point flame instantly. Used by electricians and mechanics everywhere.

60" coil self-fluxing (*acid or rosin core*) **solder 25c**
Lenk "Jumbo" (*mouth blow*) **Torch . . . $1.00**
Lenk Automatic (*blows itself*) **Torch . . . 1.50**
Marvel Soldering Kit—one Lenk Automatic and one coil each of self-fluxing acid and rosin core solder, in neat leatherette case 2.00

If your dealer cannot supply you, order direct.

LENK MANUFACTURING CO.
34 PORTLAND ST. BOSTON, MASS.

HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will show you how to

PROTECT AND PROFIT FROM YOUR IDEAS

This magazine is devoted entirely to the interests of Inventors. It opens the mysteries of Science and Invention to the student of every day problems. Sample copy free. Also send for free book,

"WHAT TO INVENT"

containing SUGGESTIONS TO INVENTORS from prominent inventors and scientists of Inventions Needed. We invite manufacturers and promoters to address us regarding any inventions or patents they may want. We will publish such inquiries without charge. Address

WORLD PROGRESS PUB. CO., INC.
Room 202 Victor Bldg. Washington, D. C.
One year's subscription $1.00

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable. Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
986 Inter-Southern Bldg. LOUISVILLE, KY.

FREE Radio Catalog

Our big stock of standard makes of radio sets, parts and supplies, fully illustrated. Play safe — buy standard equipment from a reliable house. We ship from stock.

Send $5.00 for Murdock Loud Speaker including fibre horn, stand and adjustable phone unit. Requires no battery.

JULIUS ANDRAE & SONS CO.
In business since 1860
119 Michigan Street - Milwaukee, Wis.

Catch Fish, mink, muskrats and other fur-bearing animals, in large numbers, with our new, Folding, Galvanized **Steel Wire Trap.** It catches them like a fly-trap catches flies. Made in all sizes. Strong and durable. Write for Descriptive Price List, and our Free Booklet on best bait known for attracting all kinds of fish.

J. F. GREGORY, Dept. 26, Lebanon, Mo.

The announcer's voice is distinct, the music as clear as a bell, because her radio outfit is equipped with the

Stromberg-Carlson Radio Headset

Comfortable, quickly adjustable to any size head—forked cord permits use by two observers.

Backed by 8 years' experience in the manufacture of radio apparatus and 28 years in the manufacture of high grade telephone equipment.

Order Stromberg-Carlson apparatus through your electrical dealer or write us for free bulletin No. 1029-PS describing exclusive Stromberg-Carlson features.

STROMBERG-CARLSON TELEPHONE MFG., CO.
Rochester, N. Y.

World Radio and Auto Batteries SAVE YOU 50%
WRITTEN 2 YR GUARANTEE

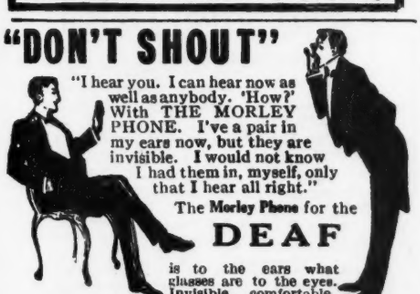
We defy price competition; a glance at the prices below will convince you that the World Battery is the best buy on the market. Batteries shipped immediately. Express C. O. D. Begin now to get 100% battery service at half cost. Mail order today.

Automobile Prices
6 Volt, 11 Plate - $12.50
Ford, Chev., Mitchell, Hup., Grant, Elgin, Velie, Saxon.
6 Volt, 13 Plate - $14.50
Overland, Buick, Reo, Paige, Hudson, Nash, Stude., Dort.
12 Volt, 7 Plate - $18.00
Maxwell, Dodge, Regal, Frank, Briscoe and Crow-Elkhart.
Give year and model of car

RADIO PRICES
6 Volt, 40 Amps. $ 8.50
6 Volt, 60 Amps. 10.00
6 Volt, 80 Amps. 12.50
6 Volt, 100 Amps. 14.50

World Battery Co., 1219 S. Wabash Ave., Dept. 7, Chicago

"DON'T SHOUT"



"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The **Morley Phone** for the **DEAF**

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless.

Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.
THE MORLEY CO., Dept. 707, 26 South 15th Street, Philadelphia

TYPEWRITERS

17c a Day soon pays for a genuine visible Underwood or L. C. Smith rebuilt Typewriter. Save $20 to $30 on famous Larkin Easy-Payment plan. Handsomely finished. 5 Year Guarantee. 30 Days' Trial. Send for FREE Book TODAY.

Larkin Co. Inc.
Desk TPSM-523 Buffalo, N. Y.

THE HOME WORKSHOP

Radio Trouble Tips

(*Continued from page 118*)

If you are in doubt about this contact, you can either bend the springs of the socket upward, or else touch a little solder to the ends of the tube prongs, being careful not to overheat them while doing it, and also seeing that the solder so applied is not bulky and lumpy.

One of the important things in connection with all double or three circuit tuners is the arrangement of the aerial tuning condenser. Many fans ask, "Which is better—to place the condenser on the aerial side of the variocoupler primary, or on the ground side?" The same question applies also, of course, to honeycomb sets.

The answer is: "On the ground side." Not only that, but the rotor plate of the condenser should be connected with the ground, and the stationary plates with the inductance, be it variocoupler primary or honeycomb coil.

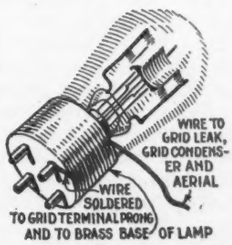
Grounding the Filament Circuit

In this connection there is another good tip for users of double circuit sets. When the aerial tuning condenser is on the ground side of the primary circuit, as described above, it is possible to ground the common filament of the secondary circuit, care being taken that the rotor plates of the secondary condenser are joined to the filament side of the circuit. This will also have the effect of the ground shielding the set, and make it much easier to adjust. There will be no direct coupling between the primary and secondary circuits, as the primary condenser separates the primary inductance from the secondary inductance.

Another tip for regenerative circuit users: Remember that no matter what means are used to obtain regeneration (with exception of plate variometers), the current flowing in the tickler coil is of a unidirectional character. In other words, it flows through the coil in one direction only. Therefore, if the direction of winding on the tickler coil is opposed to that of the primary and secondary coils, there can be no regeneration. A simple method of determining this is to reverse the connections on the tickler coil, and compare the results.

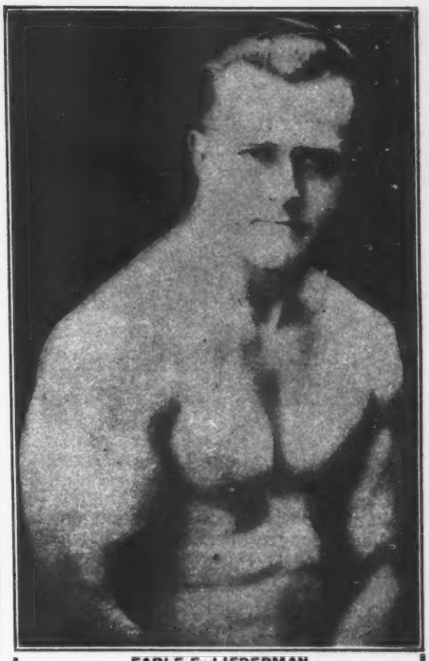
Insuring Good Grid Connections

MY SET works more satisfactorily, I find, when I insure good grid connections by soldering a small brass or copper wire to the grid prong of the vacuum tube and to the brass base of the bulb and another wire to the upper rim of the brass base. The second wire is then connected with the grid leak and grid condenser.



Connection is made through base of tube

This gives a fully soldered connection in the most important circuit of the set. I find that it reduces tube noises and adds to the efficiency of the set in bringing in distant stations with less amplification than usual.—JOHN A. MAHON, Baltimore, Md.



EARLE E. LIEDERMAN
as he is today

WHAT IS A BOOT-LEGGER?

He is nothing but a common law-breaker who exacts unreasonable prices from the public because of the chances he takes. But how many of us are almost as bad? We daily break the laws of Nature and think nothing of the terrible chances or consequences.

DO YOU KNOW THE LAW?

To look at the average man you would swear he never knew the laws of Nature or else he is just plumb crazy. He goes on stuffing any kind of food into his stomach till it sticks out like a loose meal sack, while his chest looks so flat you would think a steam roller had run over it. He stays out most of the night and then abuses his body most of the day. He never gives his lungs half a chance while his arms swing like pieces of rope with knots on the end.

FREEDOM

Cut it out fellows. Get wise to yourself. If Adam had looked like some of you, Eve would have fed him poison ivy instead of apples. This foolishness will never get you anywhere but the graveyard. Get back to Nature's laws and be a real He-man. Pull in your belt and throw out your chest. Give your lungs a treat with that good pure oxygen that is all about you and you will get a better kick than you could get out of a whole case of whiskey.

90 DAYS

Will you turn your body over to me for just 90 days? That's all it takes—and I guarantee to give you a physique to be really proud of. Understand, I don't promise this—I guarantee it. In 30 days I will increase your arm one full inch, and your chest two inches in the same length of time. And then, just watch 'em grow. From then on you will feel the pep in your old backbone. You will amaze yourself and your friends as well. Do you crave this new life—these new joys—this abounding health and strength? If you do

Send for My New 64-Page Book

"MUSCULAR DEVELOPMENT"

It contains forty-three full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now, before you turn this page.

EARLE E. LIEDERMAN
Dept. 1305, 309 Broadway, New York City

EARLE E. LIEDERMAN
Dept. 1305, 309 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name.....

Street.....

City.....State.....

Your Choice 75c a Week

No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock-bottom price at the rate of only 75c a week. But you must act now! The rising cost of paper and binding materials won't permit us to continue the present low prices much longer.

These books are the work of recognized authorities. They are written in plain, easily understood language, by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books
At Greatly Reduced Prices

Business Management, 8 volumes, well illustrated. Was $52.50 ..... Now $29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $37.50 ..... Now 19.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures, Was $67.50. ..... Now 34.80
Electrical Engineering, 8 volumes, 3800 pages, 2600 pictures. Was $60.00 ..... Now 29.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $45.00 ..... Now 21.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $45.00 ..... Now 21.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $52.50. Now 24.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $97.50 ..... Now 49.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $30.00 .... Now 14.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $30.00 ... Now 14.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $30.00. Now 14.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blue prints, etc. Was $30.00 ..... Now 14.80

Send No Money
Shipped for 7 days' Trial

Yes, we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until after you have used them seven days, then remit only $2.80 or return them at our expense. Pay balance at the rate of $3.00 a month—**75c a week.**

Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—**fill in and mail the coupon now.**

American Technical Society, Dept. X-205, Chicago

American Technical Society, Dept. X-205, Chicago, U. S. A.

Please send me set of .....

.....

for 7 days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3.00 each month, until I have paid the special price of .....
If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

To insure prompt shipment fill out all lines.

Name .....

Address .....

Employed by .....

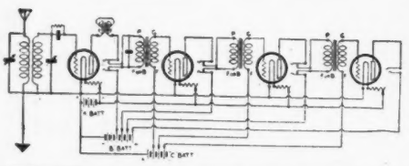
THE HOME WORKSHOP

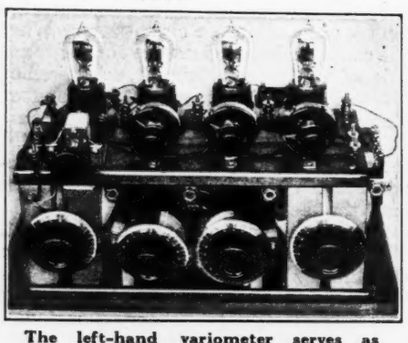
A Compact, Powerful Radio Set Built around Two Variometers

BY BUILDING a receiving set around two cheap wooden variometers, the radio fan can at once simplify the construction of his set, reduce its cost, and provide himself with an unusually compact and unique receiver.

The variometers are mounted between two boards 6 by 14 in., as shown. One half of the stator winding of one variometer forms the primary and is tuned by means of a variable condenser, while the rotary winding forms the secondary. It also is tuned by a variable condenser.

The other variometer is used in the plate circuit for regeneration. The detector and three amplifying tubes with their rheostats





The left-hand variometer serves as primary and secondary, and the right-hand variometer tunes the plate circuit. The hook-up is shown above

are mounted on top. A carbon rheostat is used for controlling the detector tube to insure close adjustments.

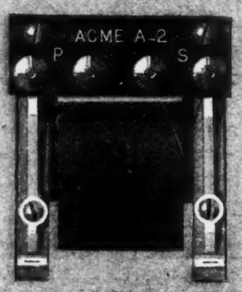
A .001 condenser is placed across the primary of the first transformer, which is mounted behind the detector. The transformers are placed as far away from each other as possible, two being fastened to the edges of the top board and the other on the bottom board.

The jacks are conveniently placed on the under side of the upper board, and the other parts and binding posts are placed where most convenient.

The set illustrated, which is used by the Art Director of POPULAR SCIENCE MONTHLY in New York, gives exceptionally good results in the reception of broadcasting and extraordinary volume on the loudspeaker. In this respect it is similar to the three-stage set described on page 98 of the April issue of POPULAR SCIENCE MONTHLY. Many of the suggestions given in that article can profitably be applied to the construction of this set. The cost of the parts and materials for the set, including batteries, telephone headset, loudspeaker, and aerial, was a trifle more than $100.—JOSEPH CALCATERRA.

IT IS not advisable to varnish new linoleum until it has been on the floor from three to six months. It should be washed with a mild solution of soapsuds before varnishing, just like a wood floor, and the soapy water rinsed off thoroughly. Grease spots may be removed with benzine.

ACME
for amplification



Radio Apparatus of distinction

ACME APPARATUS CO.
PIONEER TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS
CAMBRIDGE, MASS., U. S. A.

Stop Using a Truss

Reduced Fac-Simile Gold Medal

STUART'S PLAPAO-PADS are different from the truss, being mechanico-chemico applicators made **self-adhesive** purposely to hold the distended **muscles** securely in place. **No straps, buckles or spring attached**—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered. **Grand Prix**

Reduced Fac-Simile

Soft as velvet—easy to apply—inexpensive. Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely **FREE**
Write name on Coupon and send **TODAY:**

Plapao Co., 790 Stuart Bldg., St. Louis, Mo.

Name .....
Address .....
Return mail will bring Free Trial Plapao.

ZIP-ZIP

A great and rapid seller, something every boy wants and never gets tired of; scientifically and practically made. If you like hunting and outdoor sport get a Zip-Zip. Prong made of beautiful metal. Fine Zip-Zip rubbers with plenty of pep and force. Order from us or your dealer. Zip-Zip complete, **35c**, or three for **$1.00.**

Automatic Rubber Co.
Dept. 22, Columbia, S C.

"LIGHTING FIXTURES"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 24 and Dealers' proposition

ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

SAY!

"It's mighty easy to build up a wonderfully profitable business with very little investment. **A KINGERY POPCORN POPPER AND PEANUT ROASTER** gives you 70 cents profit on every dollar. Many styles. Popping 40 qts. to 12 bushels per hour. Roasting 10 qts. to 5 bushels at a roast. Lowest prices. Most liberal terms. Write for free catalog **Today.**

KINGERY MFG. CO.
Est. 1881. **Dept. P.S., Cincinnati, Ohio**

MOTORCYCLE BARGAINS

SAVE 25% to 65%

on **Slightly used and Rebuilt Motorcycles, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles.** Send for **Free Bargain Bulletin and Money Saving Message,** listing hundreds of **Bargains** in used, rebuilt and new machines, supplies, accessories, etc.

AMERICAN MOTOR CYCLE CO.
Dept. 517, 2047 W. Chicago Ave., CHICAGO

A Week's Free Trial (Read below)

New Style OLIVER

1923 Model NOW READY

Send now for complete details on the wonderful new Oliver Typewriter—NOW READY—"The Quiet Speedster"—the new 1923 model.

More than 1,000,000 Olivers have been made and sold. That fact alone is proof of the service and satisfaction rendered by this typewriter. And now comes the crowning achievement of twenty-eight years' experience in building typewriters—"The New Quiet Speedster."

New Features:

1 **Three-Bank Standard Keyboard.** The new Oliver has the standard three-bank keyboard. Any operator can operate the new Oliver without practice, without loss of speed or output.

2 **Silent Action.** The new Oliver is practically silent in its action.

3 **Velvet-like Touch.** The very slightest touch moves the keys of the new Oliver.

And besides, the Oliver is the most durable typewriter you can obtain anywhere. You get the wonder typewriter at the famous Oliver money-saving price.

$50 Saved

And the World's Best Typewriter Shipped to You Direct

If there ever was a machine worth $100 or more it is the new Oliver "Quiet Speedster." Because of high manufacturing efficiency and because we have no money-eating branch offices or organizations, we can save money in the producing and selling of this machine. You get the benefit of these economies. You can save over $30 on the Model 11, or, if you prefer, you can save $50 on the Model 9, which is the same as the Model 11, less a few of the more recent improvements.

Oliver No. 9 With 1923 Model Standard Three-Bank Keyboard. Monthly payment price, $55.00. Cash $49.50

Oliver No. 11 Newest improvements. Monthly payment price, $75.00. Cash, $67.50

FREE TRIAL The new Oliver will be shipped to you for a week's free trial. Use it in every way you know how. Put it to every test. If not satisfied simply send it back at our expense. If you decide to keep it, pay on terms as low as $5 a month. Get the complete details of the free trial offer.

Catalog Free

Send now for the beautifully illustrated catalog just off the press. It tells you all about Models No. 9 and 11. Get the facts on the new standard three-bank keyboard, the quiet action and light touch of the new Oliver. Learn why it is the speediest, yet the most durable typewriter. Get the complete details of our money-saving offer and the FREE TRIAL offer and easy payment plan.

The Oliver Typewriter Company
1105 Oliver Typewriter Bldg.
CHICAGO, ILL.

The Oliver Typewriter Co.
1105 Oliver Typewriter Bldg.
Chicago, Ill.

Without obligation send me booklet on Model No. 9 and on the New "Quiet Speedster" Model No.11; details of free trial offer, cash and payment plans.

Name .....
Address .....
City .....
State .....
Check which catalog you want.
No. 9..... No. 11..... Both.....

RADIO & AUTO Storage Batteries CHARGED FROM LAMP SOCKET, for a Few Cents with an F-F BATTERY BOOSTER a Full Wave Magnetic Rectifier for 105-125 Volt 60 Cycle A.C. Type A-B Charges 6 Volt "A" & Auto & Up to 120 Volts Of "B" & Loud Speaker Storage Batteries In Series Inductively At Home Overnight. Disconnecting and Multiple Connections Unnecessary. No Grounds. All Circuits Separate. Nothing Like It Made. **F-F BATTERY BOOSTERS** are Complete Portable, Automatic Charging Units. Infusible Carbon Rectifying Brushes Maintain Uninterrupted Service, at Constant Efficiency, while Full Wave Design Delivers Rapid Taper Charge. Screw Plug in Lamp Socket; Snap **CLIPS** on Battery Terminals & Battery will be Charged in Morning. No Skill is Required. **F-F BATTERY BOOSTERS** Last Lifetime & Save More Than Cost. **POPULAR PRICES.**

$15

Type 6 charges A 6 Volt Battery At 6 amps $15
Type 12 charges 12 Volt Battery At 5 amps $15
Type B charges B Batteries Up to 120 Volts $15
Type A-B is Combination of Types 6 & B $20
Type 166 charges 6 Volt Batteries At 12 amps $20
Type 1612 charges 12 Volt Batteries At 7 amps $20
Type 1626 is Combination of Types 166 & 1612 $28
3 Lower Types are for heavy Batteries, or where time is limited. **SHIPPING** Weights Complete with **AMMETER & BATTERY CLIPS** 11 to 15 lbs. Purchase from Your **DEALER**, or Mail Check for Prompt Shipment. Or if for Parcel Post, add Postage & Insurance Charges or **ORDER** Type desired Shipped **C.O.D.**

Charges Auto & Radio Batteries. ORDER Now or **WRITE** Immediately for **FREE BOOSTER** Bulletin 17.
THE FRANCE MFG. CO., CLEVELAND, OHIO, U. S. A.
Canadian Distributor: The Jack V. Elliot Co., Hamilton, Ontario, Canada.

$ DOLLARS IN HARES

Raise hares; quick easy profits. Small space; little capital necessary. Hares breed all year. 6 to 12 in litter, 4 to 6 litters a year. Sell locally for meat and fur or ship to us. We guarantee you $7 to $25 cash a pair and pay express. Book free—write today.

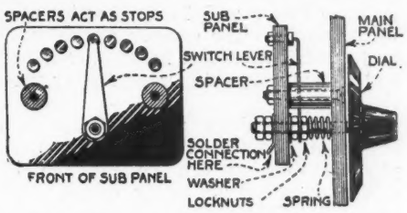
STANDARD FOOD & FUR ASS'N
407-C5 Broadway New York City

THE HOME WORKSHOP

Tuning Inductance Is Controlled by Concealed Switch

THOSE radio fans who prefer the new fashion of using concealed switch points for their tuning inductance, can make up a simple control as shown. This cost me altogether 30 cents.

The switch points are placed in a sub-panel, mounted by means of two bolts and



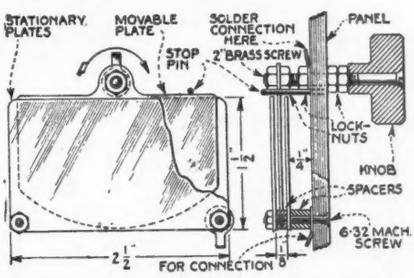
The sub panel shown at the left is mounted behind the main panel, as indicated at the right

two brass spacers behind the main panel. The switch arm shaft passes through both panels, and a dial mounted on the front of the panel serves to indicate the position of the concealed switch arm.—LESLIE S. GREENSLADE, Hamilton, Ont., Can.

Vernier Condenser for 15 Cents

ONE of the Vernier condensers on my radio set cost me only 15 cents to make. In spite of its cheapness, it is neat and as efficient as could be desired.

The plates are cut from sheet aluminum to the size and shape shown, the rotary plate being mounted between the two stationary plates. Usually there are suffi-

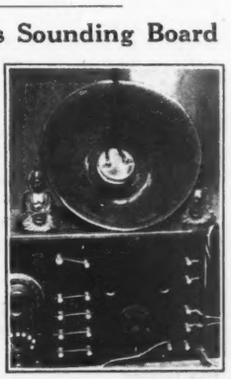


The condenser plates and method of mounting them on the panel

cient parts in the radio fan's junk box to make up one or more of these condensers without having to buy anything. A dial could, of course, be added, if it is considered desirable.—L. S. G.

Dish Serves as Sounding Board

WHEN the program of a radio broadcasting station is coming in very loud, you can throw the sound out into the room by suspending one of the telephones in front of an earthen bowl, as shown. The installation illustrated gives strikingly mellow and clear results when loud stations are being received.—K. & H.



This smoker says Edgeworth gets better and better

But it doesn't—and no "improvements" are contemplated

To begin with, we had better quote Mr. Whitlock's letter in full. Not in a boastful spirit, but so we can refer back to it farther down in the column.

2844 Accomac Street,
St. Louis, Missouri

Larus & Brother Company,
Richmond, Va.
Gentlemen:

I wish to take this opportunity to tell you what I think of your Edgeworth Plug Slice Tobacco.

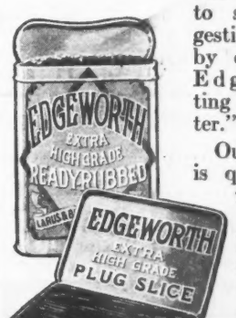
I have been a pipe smoker for about 18 years and during that time have naturally tried many different brands and blends of tobacco. I could not seem to find an ideal blend until about six months ago when, at the suggestion of a friend, I tried a pipe of Edgeworth Plug Slice.

I have been a constant user of Edgeworth since and can truthfully say that "Day by day in every way Edgeworth is getting better and better."

You have my permission to use this letter in any way you may desire if by so doing it will enable other pipe smokers to find a really cool, enjoyable and perfectly satisfactory man's smoke.

I beg to remain,
Edgeworthily yours,
Al. F. Whitlock.

We are indeed glad Edgeworth has given Mr. Whitlock such unqualified satisfaction, but we feel obliged to sidestep his suggestion that "day by day in every way Edgeworth is getting better and better."



Our constant aim is quite to the contrary.

Just as it is Edgeworth pleases thousands and thousands of pipe smokers throughout the country.

If we should try to "improve" Edgeworth or change it in the least, we might be doing an injustice to the men who have smoked Edgeworth for years and years and who expect to find it always the same good smoking tobacco.

To add to our list of friends we are always glad to send free samples of both Edgeworth Plug Slice and Ready-Rubbed.

Just drop a postcard to Larus & Brother Co., 59 South 21st Street, Richmond, Va. If you will also add the name and address of your tobacco dealer, we shall appreciate your courtesy.

To Retail Tobacco Merchants: If your dealer cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Every fighter knows the value of training

Training means as much in work as in sport.

Without training, you are helpless in competition with the trained man.

Build up your brain just as you do your muscle. Let the United Y. M. C. A. Instructor, who will take an interest in all your problems, be your trainer. He can put you "in good condition" so you can do a higher grade of work, shoulder more responsibility, earn more money, have more comforts and privileges.

Write us about your ambition. Learn what the United Y. M. C. A. Schools' correspondence-teaching service is doing for thousands of men everywhere in their spare evening hours.

Life is a real contest, calling for head work and staying power.

Begin your training for the Big Fight.
Send this coupon for our friendly counsel.

SOME OF OUR 300 CORRESPONDENCE COURSES

Technical Courses

Agricultural Courses	Farm Management	Rural Engineering
Architecture	Foremanship	Shop Courses
Automobile Courses	Highway Engineering	Blacksmith—Machine
Building Construction	MechanicalEngineering	—Foundry—Pattern
CivilEngineer, Courses	Plumbing	Steam Engineering
Concrete Engineering	Poultry Husbandry	Structural Drafting
Drafting Courses	Radio Engineering	Surveying
Electrical Courses	Radio Telegraphy	

Commercial and Other Courses

Accountancy	Business English	Insurance Courses
Advertising	Business Finance	Mathematical Courses
Applied Psychology	Business Law	Physical Directors' Tr.
Banking	English Courses	Public Speaking
Better Letters	Foreign Languages	Salesmanship
Bookkeeping	Grammar Schl. Courses	Shorthand&Typewrit'g
Business Arithmetic	High School Courses	Show Card Writing
Business Administ'tion	Illustrating	Traffic Management

Without obligating me, please advise regarding the course in

....

Name .....

Full Address.....

Dept. 73-My

Please write plainly

United Y.M.C.A. Schools

Correspondence Instruction — The most Service for the least Money

347 Madison Ave. New York City, N.Y.

Free to Writers!

A WONDERFUL BOOK—read about it! Tells how easily Stories and Plays are conceived, written, perfected, sold. How many who don't DREAM they can write, suddenly find it out. How the Scenario Kings and the Story Queens live and work. How bright men and women, without any special experience, learn to their own amazement that their simplest Ideas may furnish brilliant plots for Plays and Stories. How one's own Imagination may provide an endless gold-mine of Ideas that bring Happy Success and Handsome Cash Royalties. How new writers get their names into print. How to tell if you ARE a writer. How to develop your "story fancy," weave clever word-pictures and unique, thrilling, realistic plots. How your friends may be your worst judges. How to avoid discouragement and the pitfalls of Failure. *How to Win!* This surprising book is *absolutely free.* No charge. No obligation. *Your* copy is waiting for you. Write for it *now.* Just address

AUTHORS' PRESS, Dept. 121, AUBURN, NEW YORK

Print Your Own

cards, circulars, labels, tags, menus book, paper. Press $12. Larger $35. Job Press $150 up. CUTS EXPENSE IN HALF. SMALL OUTLAY. Pays for itself in short time. Will last for years. Easy to use, printed rules sent. Print for others, BIG PROFIT. Write factory TODAY for press catalog, TYPE, cards, paper, envelopes.

THE PRESS CO., D-33, Meriden, Conn.

THE HOME WORKSHOP

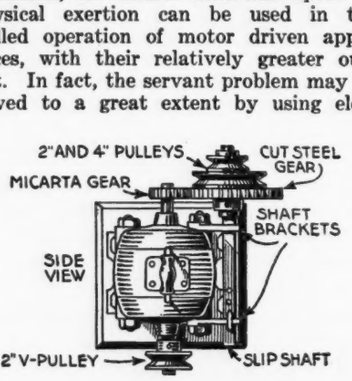
Small Motor Unit Performs Many Household Tasks

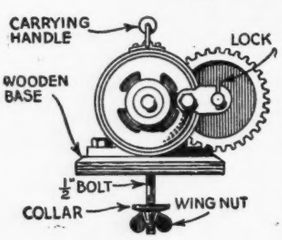
By Joe V. Romig

IF AN efficiency engineer were to walk into your home to-day, would his analysis show that too much of the work is being done by hand?

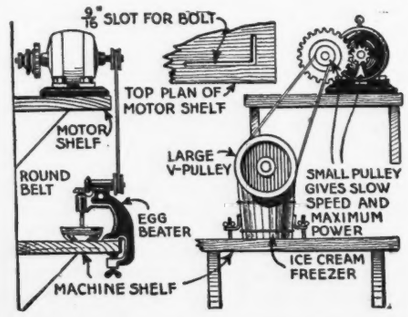
In many cases the housewife or servants are tiring themselves with work that could be done better and far quicker by using motor power. The expert's advice would be to install fractional horsepower motors and a few labor saving machines, operated electrically.

By cutting down manual labor to a minimum, the efforts otherwise spent in physical exertion can be used in the skilled operation of motor driven appliances, with their relatively greater output. In fact, the servant problem may be solved to a great extent by using electrically operated equipment in the home, which can be made to do nearly all the heavy work. Motors of ⅛, 1/6, and ¼ hp. are now available, wired to suit any phase, voltage, and cycle, and they can be bought cheaply, equipped with drop cord and plug, for attaching to any lighting circuit.





Top and end views of the motor unit showing the gearing, slip shaft, and pulley, and the method of driving an egg beater and an ice cream freezer



For the ordinary home a single ¼-hp. motor is usually sufficient, if it is equipped with reducing gearing and suitable pulleys.

To rig such a multi-purpose, general utility motor, take any good motor of standard make, and mount it on a hardwood base, as shown. In the center of the base should be sunk a ½-in. bolt, the head of which is held in a square cut hole. A large substantial iron washer and a big wingnut complete the clamping device for the motor.

Two sheet metal ears or plates are cut to shape, as shown, and fastened to the

(*Continued on page 123*)

21 Jewel Burlington

Adjusted to the Second *21 Ruby and Sapphire Jewels*
Adjusted to Temperature *25 Year Gold Strata Case*
Adjusted to Isochronism *Your Choice of Dials*
Adjusted to Positions (Including Montgomery R. R. Dial)
New Ideas in Thin Cases

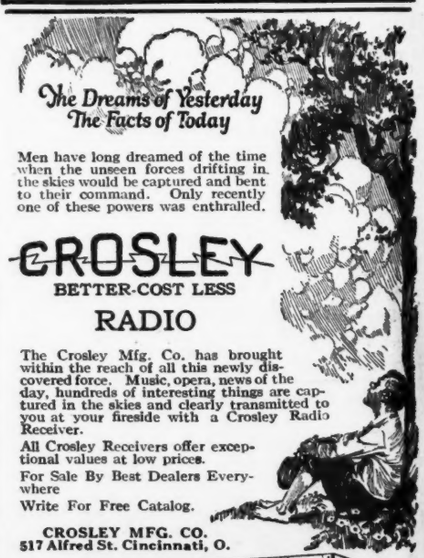
Only $1.00 Down

Only One Dollar Down will buy this masterpiece of watch manufacture. The balance you are allowed to pay in small, easy, monthly payments. A 21-Jewel Watch—is sold to you at a price much lower than that of other high-grade watches. Besides, you have the selection of the finest thin model designs and latest styles in watch cases. Write for FREE Watch Book and our SPECIAL OFFER today.

Write While This Special Offer Lasts

Get the Burlington Watch Book—write today. Find out about this great special offer which is being made for only a limited time. You will know a great deal more about watch buying when you read this book. You will be able to "steer clear" of the over-priced watches which are no better. Write for watch book and our special offer TODAY!

Burlington Watch Company
Dept 13-45, 19th St., and Marshall Blvd., Chicago



The Dreams of Yesterday The Facts of Today

Men have long dreamed of the time when the unseen forces drifting in the skies would be captured and bent to their command. Only recently one of these powers was enthralled.

CROSLEY

BETTER-COST LESS

RADIO

The Crosley Mfg. Co. has brought within the reach of all this newly discovered force. Music, opera, news of the day, hundreds of interesting things are captured in the skies and clearly transmitted to you at your fireside with a Crosley Radio Receiver.

All Crosley Receivers offer exceptional values at low prices.

For Sale By Best Dealers Everywhere

Write For Free Catalog.

CROSLEY MFG. CO.
517 Alfred St. Cincinnati, O.

CROSLEY MODEL X
A 4 Tube set of exceptional value
Price only $55

NEW SINGLE PHASE A. C. MOTORS

¼ H.P.—110 volt, 60 cycle, 1725 speed, complete with cord, plug and grooved pulley - - $13.00

General Electric ½ H.P. $30.00 Includes Pulley 110-220 Volt Rep. Ind. Type, 1725 speed.

Above motor equipped with buffer and grinder $26.00

ONE YEAR GUARANTEE

Remittance must accompany all orders.

Satisfaction guaranteed or money refunded

Illustrated Catalog of Motors and Supplies FREE

HYRE ELECTRIC CO., 625M So. Dearborn St., CHICAGO

"Let's Go—Anywhere!"

JUMP in, and -z-z-z-zip —we're off, to "anywhere"! Over highway and byway to secluded fishing waters—across a couple of states for a week-end tour—or just a peppy spin out the road and back after supper!

That's motorcycling, man —the greatest sport in the world! And a Harley-Davidson gives you everything in a motorcycle—speed, good looks, comfort, long life, low cost (fifty miles for a dollar—gas, oil, tires and all!)

Write now, for your free copy of "The Open Road." It tells all about the 1923 Harley-Davidsons, with their 10 improvements and reduced prices.

Pay As-You-Ride—ask your dealer about this new, easy way to buy a Harley-Davidson.

HARLEY - DAVIDSON MOTOR CO.
Milwaukee, Wisconsin

Money - making sales opportunities in open territory. Write Desk A-2.

Harley-Davidson
The Motorcycle

MAKE YOUR FORD INTO THIS SPORT CAR ONLY $6.40

Other types down to $3.50. Famous sure fit, Ruxtell life-size patterns and picture instructions show how. You can easily convert your Ford into this fast, saucy Sport Car as hundreds have done with a few dollars worth of material from the hardware store. No need to lay up the car. The "PAL" with conical disc wheel patterns, Pressed Metal Streamline Rear only $6.40 delivered. Built low, rides wonderfully easy. Order NOW while we can make good delivery. *Send 5c coin for illustrated prospectus of Sport Bodies "Ride" Tops and "Goswin" Windshields.*

Keen, Classy Up-to-the-Minute

KUEMPEL CO., 517 Kuempel Bldg., Guttenberg, Iowa

You Can Save $35.00

$4.45 and up Parcels Postpaid

Recover it yourself. Custom tailor made to fit all makes and models. Roof and quarters sewed together, with rear fasteners, welts and tacks, complete. Anybody can put it on. Give name, year, model number of your car. Catalog *FREE. Agents wanted.*

LIBERTY TOP & TIRE CO Dept. E8 Cincinnati, O.

THE HOME WORKSHOP

Small Motor Unit

(Continued from page 122)

side plates of the motor. In the large holes of these plates slides the slip shaft of the reducing gear device. On one end of this shaft is mounted a large gear, of a relatively fine pitch, with a two-step V pulley attached to it. The gear and pulleys are mounted on a single brass bushing and are keyed together, to drive as a unit. The small gear on the extension of the motor shaft, should be of micarta, or other silent running material, and be keyed solidly to the motor shaft.

Holes are drilled in the slip shaft for the pins that hold the gears either in or out of mesh, as required. Then, when it is desired to drive an appliance at full motor speed, or at a slight reduction, power is taken from the main motor pulley. If a greater reduction and more power is wanted, the gear is slipped into mesh with the pinion, and the power can be taken off either of the two countershaft pulleys. In this way a slow speed can be secured with a relative increase in power. A round belt is used.

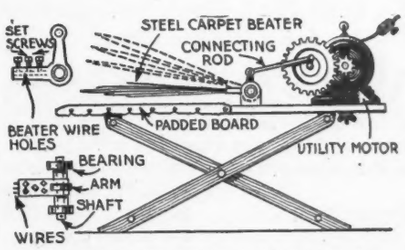
High Speed Egg Beating

Machines that require most power, such as ice cream freezers, food choppers or grinders, and dough mixers, are driven from the smallest of the geared pulleys. High speed machines are the egg beaters, cream whippers, and batter mixers.

The utility motor can be set on an overhead shelf with the power-operated machines below on a waist-high shelf. By having a slot in the upper shelf, the motor can be slid in two directions for taking up the belt slack. Most of the machines can be bought with integral clamping screws, and any homemade types should be similarly fitted.

The utility motor is also equipped with a handle so that it can be carried anywhere power is required. It can be used in the cellar to sift ashes, operate the washing machine and clothes wringer, and run small machinery in the home workshop. It can also be connected with the pump of the water storage system, if one is used.

In the kitchen its duties are obvious. It can also be used as the power plant of a



How the motor unit is used for operating a homemade carpet beater

homemade vacuum cleaner system of the type where the cleaner and motor are stationary and the cleaning and operating is done with a long hose fitted with various types of nozzles.

In the attic it can be utilized to run a mechanical carpet beater. This machine is made, as shown, out of an old ironing board. Mounted one third from the rear is a set of bearings, in which the shaft of the beater head is pivoted. The beater

(Continued on page 124)

Increase Your "A" Battery Efficiency

Hook up a Red Seal Radio Sparker to your W D-11 Tubes, instead of using a single dry cell for each tube, and you insure operating the tubes at maximum efficiency over a much longer period.

The two cell Red Seal Radio Sparker, for example, lasts from 2¼ to 3 times as long as a single cell.

With the Red Seal Radio Sparker, it is necessary to hook up only one battery. Made in 2, 6 and 8 cell sizes for operating from 1 to 4 W D-11 tubes. Full capacity, long life.

The label on each battery shows diagrams of the hook up, with complete instructions and suggestions for most efficient use.

Remember the name Radio Sparker.

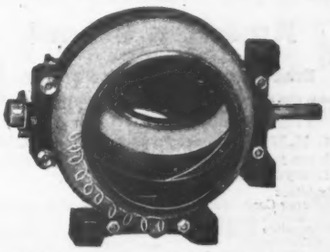
The New Manhattan
Genuine Bakelite Line

This new line of quality instruments will appeal to every radio user. In the Manhattan Variocoupler and Variometer perfect insulation and freedom from mechanical troubles are secured by use of genuine Bakelite, while electrical losses are kept down by reducing the amount of metal to the lowest point.

Bakelite mounting blocks permit installing the instruments on metal panels, if desired. Substantial pigtails connect with the rotating members, giving positive contact and quietness of operation.

The Manhattan Genuine Bakelite Knobs and Dials are non-warping, with highest precision and perfect alignment. The engraving is extremely clear.

For quality instruments ask for the Manhattan Genuine Bakelite line.



Manhattan Bakelite Variocoupler

MANHATTAN ELECTRICAL SUPPLY CO., INC.

Makers of the famous Red Seal Dry Batteries, Sparkers and Manhattan Radio Products.

New York Chicago
St. Louis San Francisco

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years.* You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School
Dept. H-575
Drexel Ave. and 58th St., Chicago

American School
Dept. H-575, Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Lawyer
.....Building Contractor	.....Machine Shop Practice
.....Automobile Engineer	.....Photoplay Writer
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Fire Insurance Expert
.....Vocational Guidance	.....Wireless Radio
.....Business Law	.....Undecided

Name .....

Address .....

Small Motor Unit

(*Continued from page 123*)

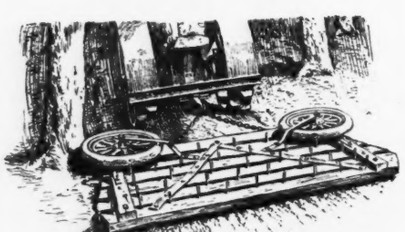
head is cast iron, drilled and fitted with a brass bushing, and also drilled for the admission of beater rods, held in place by the setscrews. The device is connected with the motor through a wooden connecting rod, which is mounted on a small crankpin screwed into the side of the smallest pulley. This beater is an ideal machine for clothes and wraps, small rugs, and pillows.

One of the handiest machines the home mechanic can make is the bottle washer illustrated. It consists of a horizontal spindle fitted with a pulley of small diameter, running in two bearings. A brush is screwed into the front end of the shaft. For washing milk bottles, fruit jars, flower vases, and a hundred and one other things, this bottle brush is most useful.

For cleaning bottles

A utility motor, with its low cost of operation and extreme flexibility, will do more than anything else to lighten the housewife's work.

Auto Wheels on Harrows Save Trees from Injury

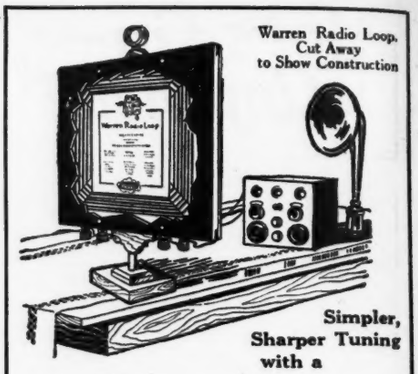


THE danger of barking orchard trees when sowing cover crops can be avoided if the harrow is fitted, as shown, with auto wheels and cheap tires. The treads of the tires should extend 4 or 5 in. over the corners at each side.—P. T.

Portable High-Chair Attachment for a Dining Chair

WITH the simple little seat illustrated, an ordinary chair can be converted into a high chair for baby. The seat is made of ⅞-in. wood and the table portion of it is arranged on two arms, the opposite ends of which are pivoted to the sides of the seat. This allows the table to swing back over the child's head.

Two small blocks on the side of the seat serve as stops for the table. Two heavy wire hooks covered with rubber tubing are attached to the back of the seat, and these are used for attaching it to the back of any straight chair. The seat and table may be painted with white enamel or finished in the natural wood to match the dining-room furniture.—J. B. MORAN.



Simpler, Sharper Tuning with a

Warren Radio Loop

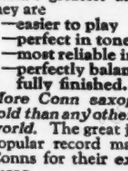
AERIAL and tuning device all in one. Tunes not only to wave *length* but to wave *direction.* An aid to selection. Eliminates atmospherics. All enclosed—dust and damp proof, fool-proof and surprisingly compact, neat and durable. Write today for Bulletin U-102, containing hookups.

A Type for Every Set At the Best Dealers

Type A-737 (300-700 meters) 6 inches square—non-directional	$10
Type A-7236 (175-1000 meters), 6 inches square—non-directional	12
Type B-2537 (300-700 meters), 18 inches square—directional	20
Type BL-2520 (200-18,000 meters), with honeycomb coil, 18 inches square—directional	25

V-DE-CO RADIO MFG. CO.
ASBURY PARK, N. J.
Dept. O.

Cultivate Your musical Bump


Ted Lewis Jazzical Clown Plays a CONN

Insist on a Conn and you'll learn to play *quickly.* For half a century Conn instruments of every kind for band and orchestra have been used and endorsed by the world's greatest artists because they are
—easier to play
—perfect in tone and tune
—most reliable in action
—perfectly balanced, beautifully finished.

More Conn saxophones are sold than any other make in the world. The great jazz kings and popular record makers prefer Conns for their *exclusive features.*
Free Trial; Easy Payments. Write for details, mentioning instrument.
Conn violins possess wonderful tone.
C. G. CONN, Ltd. 532 Conn Bldg. Elkhart, Ind.

CONN
WORLD'S LARGEST MANUFACTURERS OF HIGH GRADE BAND AND ORCHESTRA INSTRUMENTS

$25.00 in Prizes

See page 6 in front of book for full details.

The Shipshape Home

How to Do the Odd Jobs

Worm-Eaten Furniture

IN THE spring it is important to watch old furniture or furniture that is stored away, in case the wood beetle infects it. The joints and rough, unpolished parts of worm-eaten furniture should be treated with a preventive such as turpentine, benzine, or kerosene, applied with a brush and allowed to soak in as thoroughly as possible.

Often when the worms are destroyed in this way, parts of the wood will be left in a powdery condition. To harden it, apply two or three coats of size made by simmering parchment clippings for several hours in hot water. When dry, the remains of the size coatings should be removed with warm water. The decayed wood will absorb a quantity of the size and when dry will be thoroughly hardened.

The worm holes may then be filled with a wax made of three parts of beeswax heated with one part of rosin, toned to the color of the wood with raw or burnt umber.

These methods are recommended by the curator of one of the largest museums in the country.—ALLAN C. NAUDE, New York.

Choosing Brushes

PAINTING and varnishing play so important a part in the upkeep of your home and its furniture, that every home workshop should have an assortment of good brushes on hand.

A useful set of brushes includes a flat wall brush 3, 3½, or 4 in. wide for general work; a sash tool for painting small surfaces; an oval brush for trimming and painting uneven surfaces; a 7- or 8-in calcimine brush for materials mixed with water and for flour pastes, and flat or oval varnish brushes 2, 2½, or 3 in. wide for general varnishing. For furniture, trim, and other fine woodwork, a soft fitch or Russian oxhair brush is often used to avoid brush marks. A 1-in. brush is convenient for small moldings.

Clean paint brushes with turpentine, benzine, or gasoline; varnish and enamel brushes in turpentine; shellac brushes in denatured alcohol. Then wash them in soft water and soap, dry with a cloth, and wrap in paper or put in paper bags.

Brushes can also be kept by suspending them in a mixture of equal parts of turpentine and raw linseed oil. If much varnishing is done, the brushes should be kept in a non-drying varnish known as a varnish brush keeper.—M. C. S.

Regulating Gas Ranges

IF YOUR gas range does not burn with green pin flames, blending into a bluish flame, you are probably wasting a large percentage of gas. To adjust the mixture, loosen the setscrew on the air plate and open the plate as far as possible. Next turn the gas adjusting nut, immediately in front of the plate, to the right to allow a relatively large amount of gas to enter the burner. Then light the burner and turn back both the plate and the nut little by little until the proper mixture is obtained—F. L.

Yes—why don't you?
WELL—NOW
WHAT!!!!
A BULLY CONCERT AN' IM NOT IN ON IT! O MY!!
TA-RA-TA TA COME ON NOW MR. SOUSA—IM READY
NOT A RATTLE
O, BLA-A-A AN' NOT A SIGN O'JUICE
AND NOW THERE'LL BE NO MORE FUN TIL I GO GET THIS BATTERY RECHARGED
BUT DAD
JOHNNY'S POP RECHARGES IT HIMSELF - WITH THEIR 'LECTRIC CURRENT AN' A TUNGAR - WHY DONT YOU?
TUNGAR CHARGES OVER NIGHT

Is your battery always fully charged and fit?

Is it always toned up for best results, whenever friends happen in—throughout every concert?

Keep it at full strength and prolong its life—the simple, easy, inexpensive Tungar way.

Tungar—the go-between from house-lighting circuit to storage battery—attaches wherever there is a lamp or convenience outlet.

You don't have to move the battery. Just connect Tungar, and leave it—any time, day or night.

Tungar is *certain, clean, quiet.* No moving parts to get out of order or make noise.

Good for the auto battery too—the *same* Tungar.

See one at any good electrical store, or write for literature. Address Section P5.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar Battery Charger. Operates on Alternating Current.
2 Ampere Outfits—$18.00
5 Ampere Outfits—$28.00
(Prices east of the Rockies)
Special attachment for charging 12 or 24 cell "B" Storage Battery—$3.00—fits either size Tungar.

Charge 'em at Home, with

Tungar

BATTERY CHARGER

A GENERAL ELECTRIC PRODUCT

35A—96D

ELECTRICAL BLUE-PRINT DIAGRAMS *50 Valuable Diagrams for $1.25*

A valuable set of 50 Electrical Wiring Diagrams showing in detail the interior wiring and exterior connections for all classes of A C and D C Motors and their Starters. Also other complicated electrical apparatus and circuits. Invaluable to the Student, Expert Electrician, or Engineer.

THE McFARLAND BLUEPRINT WORKS
1181 Clay Street San Francisco, Calif.

N AGENTS 500% PROFIT

$60-$200 per week. Free samples **GOLD SIGN LETTERS** for store and office windows. Anyone can put them on. Big demand everywhere. Liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark, Chicago

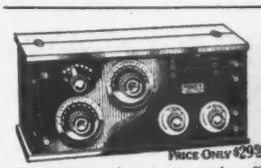
No Deposit

Just send your name, address and finger size, and we will send you this beautiful genuine diamond, 14K solid gold ring on approval. Send no money; pay no C. O. D. Merely accept the ring and wear it a week. Then decide—either return the ring and call the deal closed, or keep it and send only $3.75 a month until our cut price of $38.75 is paid. (Regular $50.00 value.)

Genuine Diamonds

Each ring is solid 14K green gold, with 18K white gold top, exquisitely hand engraved and set with a fine, large, extra brilliant, perfectly cut, blue-white genuine diamond. Order now—at once! Send name, address and finger size. Also kindly give your age and occupation and say whether you want ladies' or men's ring. Write today!

Harold Lachman Co., 200-Se Peoria Street Dept. 1785 Chicago, Ill.



MIRACO GETS 'EM 1500 MILES AWAY

PRICE ONLY $29.95

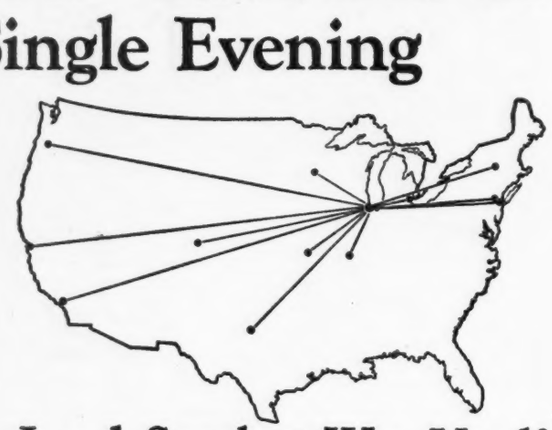
At this low price you get the efficiency of a $50 set. It is a two tube radio frequency receiver—picks up stations 1500 miles away under good conditions—everywhere—any time. This outfit can be operated with a **dry cell** or storage battery. Cabinet is of solid mahogany and workmanship the finest throughout. Order direct or send for catalog.

DEALERS—write for proposition—it's a winner.
AGENTS—wanted everywhere—write for territory QUICKLY

THE MIDWEST RADIO COMPANY
808 Main Street, Cincinnati, Ohio

What One Tube Did In a Single Evening

New York City
Newark, N. J.
Detroit, Mich.
Kansas City
Minneapolis
Denver
St. Louis
Los Angeles
San Francisco
Portland, Ore.



Erla radio frequency transformers greatly improve the range and power of any receiving set, incorporating utmost efficiency and value. Results guaranteed. List, $4

Loud Speaker Was Used!

Typical of the amazing results that are being secured daily with the new Erla Duo-Reflex circuit, using but a single vacuum tube, is the experience of Dr. G. Edwin Farley, of Beverly Hills, Ill., who writes:—

"Between 9 p. m. and 2 a. m., Dr. Duff, a friend of mine, and I, listened to New York City, Newark, Troy, Detroit, Stanford, Tex., Kansas City, Minneapolis, Denver, St. Louis, Los Angeles, San Francisco, and Portland, —all, with the exception of the last, very clear and loud. *Most were heard on the loud speaker.*

The basis of this new circuit, and the mainspring of its efficiency, is the Erla radio frequeney transformer. Free diagrams of the circuit, with notes regarding its construction, are available. Ask your dealer or write.

ERLA Electrical Research Laboratories
Dept. F, 2515 Michigan Avenue, Chicago

Earn $50 a day-

Selling men's gas-mask
GOODYEAR RAINCOATS
$1.90 each, in dozen or gross lots. Sample sent upon receipt of $2.15. *Agents wanted.* (*Write for our 6 best sellers.*)
GOODYEAR RUBBER M'F'G CO.
Dept. C - - 34 E. 9th Street, N. Y. C.

For 58 years these little marchers have led band instrument buyers to better quality and value!

Everything for the BAND PLAYER!

—from a drumstick to world's finest instruments! Used by Liberati, Army, Navy, Victor Record Makers. SEND FOR FREE CATALOG; mention Instrument interests YOU. *Free Trial!* Easy payments. Sold by leading music merchants everywhere. Write TODAY!

LYON & HEALY, 72-77 Jackson Blvd., CHICAGO

Brooks Variable Condenser

Two Ribbons Furnished Easily Interchangeable
(Max. .0005—Min. .00001)
(Max. .001—Min. .00001)

Adaptable to all receiving circuits.
Shorting of plates eliminated.
Nicety of Adjustment.
Straight line capacity curve.
Low internal resistance.
Loud Signals.

Retail Price $4.75 each
Complete with Dial

Manufactured by
METRIC METAL WORKS
of
American Meter Company, Inc.
ERIE, PA.

JOBBERS WANTED
Write for Prices and Discounts

THE HOME WORKSHOP

Sanitary Chute Carries Trash from Kitchen to Cellar

By William Draper Brinckloe

EVER notice how fast kitchen trash collects? Empty cartons, cans, broken china, wrapping paper—there's a good sized box of it every day or so.

Here's a suggestion for making a chute to take care of the rubbish in a sanitary way and, at the same time, to save steps and labor. If there is a cupboard in your kitchen something like that illustrated, you can utilize half the lower part, which usually is not of much value because of the stooping necessary to get at things down there. If no cupboard is available, a boxlike compartment can be built under the sink drainboard or in some other convenient location.

If a cupboard is to be used, we'll take off one door, build a little partition of matched boards, dividing the lower part

The pivoted door to the chute is self closing

in halves, and cut out the shelf in the left-hand half. Next, we'll saw away the floor boards in this portion, leaving a hole right through to the cellar. We must make this hole as large as possible, which will be easy enough if the joists run as shown. If they run the other way and one cuts across the hole, we'll bevel the top edge.

Next, we'll replace the door, hanging it on pivots, a little above the center. "Surface sash pivots" can be bought at the hardware store, or twelvepenny nails, or larger, can be put through the frame, at each side, into the edge of the door. Bore holes for the nails, so that they fit rather loosely; they then can be easily pulled out to take the door off for cleaning or whitewashing the chute.

There ought to be a stop projecting from the inside of the frame, near the top, so that the door cannot swing inward. A small block or bent nail will answer. We must also put a knob or handle at the top of the door.

Now, suppose your wife is standing at the sink, opening a can of salmon, or unwrapping the meat. As she finishes, she pulls the door open a bit, and drops down the empty can or soiled paper. Or sup-

pose she is sweeping the kitchen; she collects the litter in a heap in front of the door and with a brisk stroke of the broom pushes back the bottom of the door, and sends all the rubbish to the cellar.

You can set an ashcan or box to catch the litter on a shelf, so that the top of the receptacle will be near the under side of the hole. A better scheme, perhaps, is to make a cage of heavy wire netting. An old square baking pan will do for the bottom; punch holes around the rim with a nail, and fasten the netting by twisting wires through these holes.

Every so often, as this cage gets full, carry it to the back yard, set it down, and touch a match to the contents. When the fire is out, empty the residue of ashes, cans and broken china into the ashcan. The burning will purify this cage perfectly.

Whitewash the inside of the door and the chute every now and then.

In This Issue

	PAGE
Editorials	2
What Scientists Are Saying	27
Airplanes to Dispel Fog	29
My Adventures with Laughter	31
An Interview with Will Rogers	
Man—An Animal Invention	32
Article 3 in the Series, "The Story of Man and His World"	
By E. E. Free, Ph.D., and William K. Gregory, Ph.D.	
A Baby—An Open Safety Pin	35
Thumbprints to Identify Paintings	36
Is Milk the Perfect Food?	37
A New Broadcasting Plan	38
By Jack Binns	
Miniature Plane Trains Gunners	39
Autos Weighed without Jacks	39
Are You Too Fat?	40
Hooligan Fish Burn as Candles	42
Air Cooling for Automobiles	43
What Bright Lights Cost New York	44
Automatic Quartermaster Steers Ship	44
Alarm Clock Switches off Lights	44
Illuminated Lifeline	45
Midget Cyclecar Coupé	45
Boring Highway under the Hudson	46
Postage Stamps Form Mosaic	48
World's Largest Handsaw	48
Container Sponge Spreads Mucilage	48
Car Is Track for Unloader	48
Rented Goats Clear Farm Land	49
Oblong Lens Detects Counterfeits	50
Motorized Bucket Cleans Sewers	50
Chickens Eat "Cafeteria Style"	51
Hand Crank Runs Truck Loader	51
Auto Speeders Checked Automatically	51
Motor Driven Bracket Drill	51
Fisherman Goes to Sea in Wagon	52
Speedball—The Newest Sport	52
Dope—Where It Comes From	53
An Interview with Dr. Carleton Simon	
Building a Giant Airship Hangar	54
Tiny Motor Starts Novel Glider	55
Switch in Handle of Trouble Lamp	55
Mushroom Matures in 12 Hours	55
Electric Log Tells Ship's Speed	56
Self-Holding Shoe Last	56
Using Electricity to Age Wine	56
Concrete Armor to Protect Piles	57
Automatic Road Building Truck	57
Portable Jointed Tube Bridge	58
Movie Screen Shows Embryo Growth	58
Three-Inch Walls Keep Out Noise	59
Ballast Cleaner for Railways	59
The Month's Novelties in Photos	60
Blizzard Warnings from the Arctic	61
Sliding Celluloid Windows for Autos	62
Ruler Serves as Blotter	62
Colors Fused into Glass	62
Aircushion Rowboat Tied in Bundle	62
Manikins Used by Auto Designer	63
Shockproof Wheels for Motor Truck	63
5000 Fathoms under the Sea	64
A Dozen Machine Tools in One	65
The World's Queerest Animal	66
New Wing Flap Airplane Control	66
To Broadcast Baseball by Radio Movies	67
Peanuts in 145 Varieties	68
Iron Finger Finds Sunken Treasure	69
Labor Saving Household Devices	70
Bandsaw Cuts Wood or Metal	71
Tree Branches Spliced by Grafting	71
A New Way to Pull Weeds	71
Cart Serves as Camping Table	71
Angler Outdistances Babe Ruth	72
How Climate Affects Your Energy	72
Searching for "Lost Pharaoh"	73
Conveniences for Spring Touring	74
How to Cut Your Car Costs	75
By Harold F. Blanchard	
Tire Changing Champions	77
Handy Toolboxes for Your Car	78
Enlarging a Steering Wheel	78
Two Spark Plug "Kinks"	78

The Home Workshop . . Page 79

Better Shop Methods . . Page 84

The FLORSHEIM SHOE

WITH all their refinement FLORSHEIM SHOES are sturdy—enduring. Style is a part of them—not merely a surface finish.

The Florsheim Shoe—Most Styles $10

BOOKLET "STYLES OF THE TIMES" ON REQUEST

Look for Name in Shoe

THE FLORSHEIM SHOE COMPANY

Manufacturers • CHICAGO

The Pathfinder — The Florsheim Shoe — *Style M-112*

Easy to Play
Easy to Pay

Clyde C. Doerr, B. M.,

Director Club Royal Orchestra, makers of Victor Records for dancing. Hear their Buescher instruments on your phonograph.

The Most Prominent Professionals

Use True-Tone Musical Instruments. They have helped make famous Paul Whiteman, Tom Brown, Art Hickman, Donald Clark, Clay Smith, Guy Holmes, Meyer Davis, Joseph C. Smith, Ben Selvin, Ben Krueger, Henry Santrey, Vincent Lopez and thousands of others. $500 to $1,000 weekly for but two hours a day is not uncommon for musicians of such ability to earn. You may have equal talent and enjoy the most pleasant of vocations. 75% of all popular phonograph records are played with Buescher instruments.

Free Saxophone Book

After nearly 300 years' supremacy, almost entirely displaced by Saxophones in all nationally popular orchestras. Our Free Saxophone Book tells which Saxophone takes violin, cello and bass parts, and many other things you would like to know. Ask for your copy.

Sax Invented the Saxophone Buescher Perfected It

You will be astonished at the ease with which you can master a Saxophone. It is the easiest of all wind instruments to play and one of the most beautiful. Three first lessons sent free. You can learn the scale in an hour's practice and play popular music in a few weeks. Practice is a pleasure because you learn so quickly. You can take your place in a band within 90 days if you so desire.

BUESCHER

True-Tone Saxophone

Unrivalled for home entertainment, church, lodge or school. In big demand for orchestra dance music. Buescher popularity and superiority is proven by the fact that Buescher makes more Saxophones than all other manufacturers combined.

Free Trial—Easy Paymants

You may order any Buescher Saxophone, Cornet, Trumpet, Trombone, or other Band or Orchestral Instrument without paying in advance, and try it six days in your own home, without obligation. If perfectly satisfied, pay for it on easy payments to suit your convenience. Mention the instrument interested in and a complete catalog will be mailed free. Send the coupon for a free copy of the most interesting booklet on the Saxophone ever published.

BUESCHER BAND INSTRUMENT CO.

Makers of Everything in Band and Orchestra Instruments

3165 Buescher Block Elkhart, Indiana.

BUESCHER BAND INSTRUMENT CO.
3165 Buescher Block, Elkhart, Indiana

Kindly mail to me Saxophone Book.
Shall we also send you free Complete Catalog of all Buescher True-Tone Brass Band Instruments?

Name.....

P. O. Addres.....

.....

Instrument I play is.....

Cunningham

Tubes for Every Requirement

Vacuum tubes are used for two distinct individual purposes in a receiving set—as DETECTORS and as AMPLIFIERS. The qualifications of a tube for these two uses are so different that for maximum efficiency tubes of entirely different design must be used.

This point was one of the chief considerations of the research engineers who designed Cunningham tubes in the great laboratories of the General Electric Company. After years of research and experimental work, the Cunningham C-300, a SUPER-SENSITIVE DETECTOR, the Cunningham C-301, a DISTORTIONLESS AMPLIFIER, and the Cunningham C-301A, a LOW FILAMENT CURRENT AMPLIFIER, were developed. These three tubes, now nationally recognized as standards for all types of receiving sets, are responsible for the highly perfected results obtainable in radio phone reception.

The trade mark GE is the guarantee of these quality tubes. Each tube is built to most rigid specifications.

TYPE C-300
Super-Sensitive
DETECTOR
$5.00

TYPE C-301A
¼ Amp. Fil-Current
Amplifier and Detector
$6.50

Patent Notice—Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

E. T. Cunningham

Home Office:
248 First Street
San Francisco, Calif.

Eastern Representative:
154 West Lake St.
Chicago, Illinois

THE ART COLOR PRINTING CO., NEW YORK